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# ERRATA

Page 2, line 8
for Schltr. read Schlechter

Page 4, line 21
omit Beih.

Page 5, line 27
for T read I

Page 6, line 27
for Murayaco read Murayaca

Page 65, line 2
for cretaceous read Cretaceous

Page 65, line 13
for cambrian read Cambrian

Page 68, line 24
for cretaceous read Cretaceous

Page 69, line 6
for proterozoic read Proterozoic

Page 137, line 2
for *tomato* read tomato

Page 140, line 18
for **emarginatus** read **marginatus**

Page 147, line 17
add *L.* after **S. Mombin**

Page 153, line 16
for *emarginatus* read *marginatus*

Page 153, line 36
for *viridis* read *viride*

Page 156, line 2
for *cherimolia* read *Cherimolia*

No. 8, Explanation of Plate XXX, line 4
for *Tetrapteria* read *Tetrapteris*

No. 9, throughout
for Belles Artes read Bellas Artes

No. 9, Table I, last column, line 5 (data for *Tripsacum latifolium*)
for 1:1.4 read 1:4.1

# BOTANICAL MUSEUM LEAFLETS
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# MISCELLANEOUS NOTES ON TROPICAL AMERICAN ORCHIDS


BY

CHARLES SCHWEINFURTH


THE following miscellaneous notes regarding Tropical American Orchids include the description of new varieties, nomenclatural changes and amplifications of older species.

The order of genera follows the system proposed by R. Schlechter in Notizblatt des Botanischen Gartens und Museums Berlin-Dahlem 9 (1926) 563–591.

**Gomphichis Koehleri** *Schltr.* var. **minor** *C. Schweinfurth var. nov.*

Herba quam species typica multo humilior, cum foliis minoribus et vaginis caulinaribus approximatis et sepalis extus conspicue pilosis, non subglabris.

Plant about 6.6 dm. high differing strikingly from the type in its much smaller vegetative size throughout. Roots (not described in the type) fascicled, tuberous, long, simple, lanuginose. Leaves five or six, basal or subbasal, oblong-ligulate, acute, slightly narrowed below, up to 13 cm. long and 1.5 cm. wide. Stem stout, nearly concealed by about eight tubular acute sheaths. Raceme densely many-flowered, about 8 cm. long (with the apical flowers undeveloped in our specimen). Flowers yellowish cream-color, not whitish as in the type.

Sepals conspicuously pilose without. Parts of the perianth apparently closely similar to those of the type.

PERU: Cuzco, Prov. of Paucartambo, Tres Cruces, at 3600 meters altitude, terrestrial in humus of forest glade, October 1941, *C. Vargas 2257* (TYPE in Herb. Ames No. 66059).

**Altensteinia chiogena** (*Schltr.*) *C. Schweinfurth comb. nov.*

*Aa chiogena* Schltr. in Fedde Repert. Beih. 10 (1922) 35; Mansfeld in Fedde Repert. Beih. 57 (1929) t. 134, nr. 524.

**Altensteinia Weberbaueri** (*Schltr.*) *C. Schweinfurth comb. nov.*

*Aa Weberbaueri* Schlechter in Fedde Repert. Beih. 9 (1921) 53; Mansfeld in Fedde Repert. Beih. 57 (1929) t. 105, nr. 413.

Since the generic concept *Aa* appears to be inseparable from *Altensteinia*, the above nomenclatural changes are necessary.

**Buchtienia boliviensis** *Schlechter* in Fedde Repert. 27 (1929) 34.

This monotypic genus, originally limited to Bolivia, has lately been recognized from Peru. The collection cited is somewhat lower in stature than the type. It shows one leaf about 48.4 cm. long (in contrast to the cited maximum length of 40 cm.), while the lamina, which is oval, rather than elliptic or elliptic-oblanceolate, has a maximum length of 23.5 cm. (as contrasted with 22 cm.), and a maximum width of 13 cm. (in comparison with 10 cm.). Moreover, the base of the blade appears to be sometimes subcordate and not cuneate as cited. The flowers of the Peruvian collection are noted as rose-colored, whereas those of the Bolivian type are designated as greenish. The parts of the perianth are very similar in

both cases, but the Peruvian collection has the mid-lobe of the lip oblong-ovate and only 3 mm. long, while that of the Bolivian type is lanceolate and 4 mm. long.

PERU: Cuzco, Prov. of Paucartambo, between Mistiana and Keros, at 700 meters altitude, terrestrial in dense shady forest, 1.20 meters tall, July 27, 1948, *C. Vargas 7381*.

**Stelis Endresii** *Reichenbach filius* in Gard. Chron. (1870) 1373.

*Stelis Huebneri* Schlechter in Beih. Bot. Centralbl. 42, Abt. 2 (1925) 88.

A study of the description of the Brazilian *Stelis Huebneri* and especially of several Peruvian collections shows that this concept is synonymous with the widely distributed Middle American *S. Endresii* which extends from Mexico through Costa Rica to Panama and Venezuela.

PERU: Huánuco, six km. south of Tingo María, at 738 meters altitude, along road, on tree trunk in moist forested valley, flowers pale green with purplish base, December 2, 1945, *R. J. Seibert 2257*.— Loreto, Upper Marañon River, at mouth of the Santiago, at 160 meters altitude, epiphyte in rain-forest, September 19, 1924, *G. Tessmann 4087;* Above Pongo de Manseriche, on right bank of Río Santiago, at 200 meters altitude, on horizontal limb of tall tree, flowers pale green, December 6, 1931, *Y. Mexia 6232;* Vicinity of Iquitos, at 100 meters altitude, epiphyte in dense forest, flowers mignonette and brownish, January–February 1937, *G. Klug 10069*.

**Stelis eublepharis** *Reichb.f.* var. **glabriflora** *C. Schweinfurth var. nov.*

Planta herbae typicae similis sed floribus supra densis glabris differt.

Plant small, with an ascending rhizome (not evident in the type). Secondary stems concealed by 3–4 tubular imbricating sheaths, about 5 cm. or less tall. Leaf solitary, long-petioled, up to 5.9 cm. long; lamina oblong-elliptic or elliptic-oblanceolate, acute or subacute, gradually cuneate below, up to 4.5 cm. long and 1 cm. wide.

Inflorescences 1–2, shorter than to somewhat exceeding the leaves, up to 8 cm. long, commonly many-flowered, densely flowered above. Floral bracts small, but spreading and conspicuous. Flowers small, more or less secund, glabrous, yellow and purple or bright yellow. Sepals connate below, 3-nerved. Dorsal sepal ovate or broadly ovate, acute, about 3 mm. long and 2.4 mm. wide. Lateral sepals a little smaller, round-ovate, subacute. Petals much smaller than the sepals, transverse, suborbicular-oval, with a fleshy-thickened broadly rounded apex. Lip in natural position triangular-ovate, obtuse, fleshy, with a transverse, convex or subbilobed callus near the base, about 1 mm. long and wide.

PERU: Cuzco, Prov. of Quispicanchis, Cachubamba, Marcapata, at 2800 meters altitude, epiphyte, perianth yellow and purple, December 12, 1943, *C. Vargas 3818* (TYPE in Herb. Ames No. 65225); Prov. of Urubamba, Machu Picchu, at 2050 meters altitude, on rocks, perianth bright yellow, January 8, 1946, *C. Vargas 5544* (this collection consists of a single plant which is much smaller throughout than the type).

**Stelis Herzogii** *Schlechter* in Fedde Repert. Beih. 12 (1913) 484; Mansfeld in Fedde Repert. Beih. 58 (1930) t. 20, nr. 80.

This concept, which has been noted as occurring only in Bolivia, has now been extended to Peru by the collection cited below. These specimens show some discrepancies from the description. The inflorescences vary from one to eight, rather than from three to five, and are either shorter or longer than the leaf, reaching a length of 9 cm., rather than 5 cm. as cited. The dorsal sepal is commonly 1.5 mm. long, instead of about 1 mm. long, and the lip is subquadrate-obovate, rather than rhombic-oval, as specified.

PERU: Cuzco, Prov. of Quispicanchis, Hda. Itío, Marcapata, at 2000 meters altitude, in sunny rocky places, flowers yellow, January 27, 1943, *C. Vargas 3114*.

**Stelis Koehleri** *Schlechter* in Fedde Repert. 10 (1912) 386; Mansfeld in Fedde Repert. Beih. 58 (1930) t. 21, nr. 82.

On the basis of additional collections referable to this species, it appears advisable to point out several discrepancies from the original description. These specimens show stems as long as 8.5 cm., whereas the description cites a maximum length of 4 cm. The leaf, which is described as oblanceolate, appears to be rarely narrowly obovate, and it attains a length of 9.5 cm., rather than the cited maximum of 7.5 cm., and a width of 2.5 cm., as contrasted with 1.5 cm. The flowers are often markedly larger than specified, the dorsal sepal attaining a length of 6.7 mm., rather than the cited 3 mm. The lip, when viewed from the front, is transversely ovate, broadly rounded or rounded-truncate in front commonly with a minute apicule in the middle and with the basal portion occupied by a transverse fleshy bilobed callus. As described and drawn, the lip is semiorbicular with a truncate apex and a transverse hollow in the middle.

Peru: Huánuco, Mito, at about 2760 meters altitude, in dense mats on dirt ledges of shrubby southwestern slopes, July 8–22, 1922, *Macbride & Featherstone 1394*; Same locality, altitude and habitat, April 8–18, 1923, flowers dark reddish yellow or deep yellow, scentless, *J. F. Macbride 3284*.

**Stelis leucopogon** *Reichenbach filius* Beitr. Orch. Centr.-Am. (1866) 95, t. 9, figs. T, 1–4.

This concept, which is frequent in Central America from Guatemala to Panama, is now recorded from Peru.

Peru: Huánuco, Muña, at about 2150 meters altitude, in dry woods, *Macbride 4195*.—San Martín, on ridge east of Tingo María, at 625–1100 meters altitude, in jungle, *Allard 22201, 22595*.

**Stelis Lindenii** *Lindley* Orch. Linden. (1846) 3, no. 17; Fol. Orch. Stelis (1858) 5, no. 29.

This species, which was described from Venezuelan

material, has been collected in three Peruvian localities.

While the type collection consists of an incomplete secondary stem without any indication of a rhizome, all three of the Peruvian specimens show a creeping rhizome with more or less remote stems.

PERU: Cuzco, summit of Ccochayoc, at 1000 meters altitude, February 21, 1931, *C. Bues s.n.*; Prov. of Convención, Hda. Potrero, Sapan Sachayocc, at 2200 meters altitude, epiphyte in forest, flowers white, March 5, 1942, *C. Vargas 2555*; Machu Picchu, at about 2100 meters altitude, May 22, 1915, *O. F. Cook & G. B. Gilbert 866*.

**Stelis phaeomelana** *Schlechter* in Fedde Repert. 27 (1929) 45.

Whereas the type of this species came from Bolivia, a Peruvian collection referable to this concept has recently appeared.

The plants forming this collection show some discrepancies from the description and from other examples of the type. One stem is 22 cm. long, in comparison with the cited length as about 15 cm. The lamina of one leaf is 16 cm. long, as contrasted with the attributed maximum length of 14 cm. The inflorescences appear to be always solitary, not only in this Peruvian material, but also in all of the plants comprising the isotype Bolivian collection in the Ames Herbarium, despite the statement that the species always has two inflorescences. The flowers appear to be slightly larger than those of the type.

PERU: Cuzco, Prov. of Quispicanchis, region of Murayaco and Marcapata, at 1960 meters altitude, on rocks in sunny places, flowers yellowish green, January 28, 1943, *C. Vargas 3134*.

**Stelis polycarpa** *Schlechter* in Fedde Repert. 27 (1929) 46.

Although this concept has previously been noted only as a native of Bolivia, several Peruvian collections are now available. One of these collections shows a dorsal

sepal conspicuously larger than that of the type, measuring 4.7 mm. long.

PERU: Cuzco, Prov. of Paucartambo, S. Pedro to S. Isabel, at 1350 meters altitude, on trunks of old trees, December 6, 1947, *C. Vargas 6785*.—Huánuco, left bank of Río Guallaza, above Cayumba, at 805 meters altitude, in small colonies on forest tree-trunks, October 19, 1936, *Y. Mexia 8313a*.—Loreto, Pumayacu, between Balsapuerto and Moyobamba, at 600–1200 meters altitude, epiphyte in forest, August–September 1933, *G. Klug 0.18*.

**Stelis santiagoensis** *Mansfeld* in Notizbl. Bot. Gart. Berlin 10 (1928) 239.

Several discrepancies from the description were noted from an examination of a photograph and a flower from the cotype in the Ames Herbarium. The leaf is somewhat larger than specified—up to 13 cm. long and 1.9 cm. wide, as compared with 9–12 cm. long and 1.2–1.8 cm. wide. The inflorescence appears to have a distinct and rather elongate peduncle below the raceme, instead of bearing flowers almost to the base. The dorsal sepal has a maximum length of 3 mm., rather than 2.1 mm. The lip is strictly simple, instead of shortly trilobulate, and is about 6 mm., instead of 3 mm., long. The number of this cotype collection is *4086*, rather than *4068*.

**Stelis simacoensis** *Schlechter* in Fedde Repert. 27 (1929) 47.

This concept was described from Bolivian material, but a Peruvian collection is now available. In these specimens the stems are 2–8 cm. long, rather than 3.5–5 cm. long as cited. The lamina of the leaf, which is sometimes oblong-elliptic rather than oblong-ligulate, has a maximum length of 8.4 cm., instead of 6.5 cm., and the petiole reaches a length of 1.8 cm., rather than 1.3 cm. as stated. The callus of the lip appears to be near the apex, instead of nearly in the middle.

PERU: San Martín, Zepelacio near Moyobamba, at 1200–1600 meters altitude, epiphyte in forest, flowers cream-color, January 1934, *G. Klug 3520*.

**Lepanthes tracheia** *Reichenbach filius* in Flora 69 (1886) 557.

A Peruvian collection, which has been referred to this Colombian species, is characterized as follows.

Plants very small, 4 cm. or less tall, as compared with 2.6–6.2 cm. high as shown by a drawing of *L. tracheia* from the Reichenbach Herbarium. Leaf suborbicular-ovate (rarely triangular-ovate), with a subcordate base, rather than elliptic-ovate as shown in the drawing, the size being about 1.2 cm. long and 9 10 mm. wide, as compared with 1.5–2.5 cm. long and 9–17 mm. wide in the figure. The sepals appear to be very similar to those depicted in an analysis of *L. tracheia* from the Reichenbach Herbarium. The petals are ciliate and pubescent (not depicted nor described) and the posterior lobe is oblong-lanceolate or linear-lanceolate and is narrower than shown in the analysis.

PERU: Cuzco, Prov. of Paucartambo, San Pedro to Sta. Isabel, at 1350 meters altitude, on old tree trunks, flowers reddish wine-color, *C. Vargas 006783*.

**Lepanthes trachysepala** *Schlechter.* in Fedde Repert. Beih. 7 (1920) 100; Mansfeld in Fedde Repert. Beih. 57 (1929) t. 34, nr. 130.

A Peruvian collection, consisting of a single specimen, has been referred to this Colombian species.

Plant about 25 cm. high, as in the type. Stem about 14 cm. long, contrasted with 5–7 cm. long as described. Leaf oblong-elliptic, acute and 4.9 cm. long, as compared with oblong, obtuse and 2.5–3.5 cm. long in the type. Raceme about 8-flowered, rather than 8- to 12-flowered. Flowers red with yellow spots, as contrasted with pale brown. Sepals about 9 mm. long, only 7 mm.

long in the description. Lateral sepals long-acuminate, rather than acute or subacute. Petals 6.5, not 5.5, mm. long. Lamina of lip not embracing the column at the base, when expanded, triangular-ovate, not lanceolate-triangular as described.

PERU: Cuzco, Prov. of Urubamba, near Wenner Gren ruins, at 3400–3600 meters altitude, in dense wet dark forest with much fog and rain, *R. D. Metcalf 30769*.

**Pleurothallis citrina** *Schltr.* var. **elliptica** *C. Schweinfurth var. nov.*

Planta major, caulibus altioribus, foliorum lamina elliptica vel oblongo-elliptica, inflorescentiis duplo longioribus et labello majore a specie differt.

Stems more or less arcuate, up to 15 cm. long, with several (up to 7), close, tubular sheaths. Leaf short-petioled, 4.1–11.5 cm. long; lamina elliptic to oblong-elliptic, 3.5–10 cm. long, up to 2.8 cm. wide. Inflorescences about 4–6 cm. long. Flowers yellow, very similar to those of the type. Lip somewhat larger than that of the species, oblong, about 3 mm. long.

PERU: Puno, Prov. of Carabaya, Ollachea (abajo), at 2500 meters altitude, on rocks, December 30, 1947, *C. Vargas 6936* (TYPE in Herb. Ames No. 65081).

**Lepanthopsis microlepanthes** (*Griseb.*) *Ames* in Bot. Mus. Leafl. Harvard Univ. 1, No. 9 (1933) 24, fig.

*Pleurothallis microlepanthes* Grisebach Fl. Brit. W. Ind. Isl. (1864) 610; Cogniaux, in Urban Symb. Antill. 6 (1909) 430; Fawcett & Rendle Fl. Jam. 1 (1910) 65.

*Lepanthes Leonii* C. Schweinfurth in H. Léon. Fl. de Cuba 1 (1946) 362.

A recent review of the concept, *Lepanthes Leonii*, which was described in Dr. Hermano Leon's Flora de Cuba, has indicated that this little orchid is referable to

the older *Lepanthopsis microlepanthes* (Griseb.) Ames. The complete synonymy appears above. This species occurs in Cuba and Jamaica.

**Malaxis termensis** (*Kränzl.*) *C. Schweinf.* var. **elata** *C. Schweinfurth var. nov.*

Herba altitudine majore, foliis late ovatis conspicue acutis, floribus minoribus a specie differt.

Plant apparently with a creeping rhizome. Stems about 43 cm. high including the rachis of the inflorescence, only slightly thickened below. Lower part of stem concealed by two or more tubular sheaths of which the upper are elongate and leaf-bearing. Leaves 2, subopposite, broadly ovate, sharply acute, appearing sessile, but abruptly contracted into sheaths, about 9 cm. long, up to 6.1 cm. wide, about 14–16.5 cm. above the base. Inflorescence abbreviated, subumbellate, many-flowered. Flowers very small, membranaceous, greenish. Sepals with strongly revolute sides. Dorsal sepal oblong-lanceolate, obtuse, about 2.3 mm. long and 1 mm. wide. Lateral sepals obliquely oblong-ovate, obtuse, subequally long with the dorsal sepal, but wider (about 1.3 mm.). Petals linear, obtuse, shorter than the sepals. Lip suborbicular-ovate, abruptly narrowed to a blunt apicule, with a large 2-celled concavity below, about 1.7 mm. long and slightly broader. Column minute.

PERU: Amazonas, Prov. of Bongara, Pomocochas, at about 2400 meters altitude, terrestrial in ridge forests above Quebrada Santa Rosa, northeast across Lake Pomocochas, April 4, 1944, *W. H. Hodge 6152* (TYPE in U.S. Nat. Arb. No. 183663).

**Epidendrum cyperifolium** *C. Schweinfurth nom. nov.*

*Epidendrum microtos* Reichenbach filius var. *grandiflorum* C. Schweinfurth in Bot. Mus. Leafl. Harvard Univ. 11 (1943) 98.

? *Bletia ensiformis* Ruiz & Pavon Syst. Veg. (1798) 230.

Renewed study of the specimen previously considered to be a variant of the inadequately described *Epidendrum microtos* shows that it should be elevated to specific rank. The reasons for this course of action are: (1) the plant under consideration is represented by complete specimens (whereas *E. microtos* was described only from a flowering panicle); (2) the flowers of this plant are larger with oblanceolate and acute (not spatulate and obtuse) petals; and (3) the lip is truly emarginate (not rounded in front).

Judging from a photograph of *Bletia ensiformis* from the Pavon Herbarium, it seems highly probable that the latter concept is referable to this species. However, an examination of the flower is impossible, so the definite reduction is open to question.

**Epidendrum inamoenum** *Kränzl.* var. **robustum** *C. Schweinfurth var. nov.*

Herba caulibus et foliis multo robustioribus et floribus majoribus et petalis latioribus sepalis subaequantibus a specie differt.

Plant up to 2 m. high (according to the collector), simple or branched. Sheathed stems 1–1.3 cm. in diameter, leafy. Leaves oblong to oblong-elliptic, rounded and minutely bilobed at the apex, slightly narrowed at the semiamplexicaul base, up to 15 cm. long and 3 cm. wide. Raceme recurved or nodding, densely several- to many-flowered, 3–6 cm. long, without any subtending spathe. Flowers larger than those of the type, pale yellow or pale greenish yellow. Dorsal sepal elliptic-lanceolate, acute, about 17 mm. long and 7–8.5 mm. wide. Lateral sepals obliquely elliptic-ovate, complicate-mucronate, about 18–20 mm. long and 8–9 mm. wide. Petals ellip-

tic to oval, subacute to rounded at the apex, about 14–16 mm. long and 7–10 mm. wide. Lip adnate to the column up to its apex, suborbicular-ovate in outline, simple to lightly but distinctly trilobed at the apex, cordate at base, about 12–14 mm. long in the middle (from the cordate base to the rounded or triangular-acute apex) and 15–17 mm. wide; disc bicallose at base, with the central longitudinal portion thickened. Column very short and stout.

PERU: Cuzco, Prov. of Urubamba, "Kil. 97–108, F. C. C. S. A." at 2200 meters altitude, on rocky slope, May 16, 1943, *C. Vargas 3408* (TYPE in Herb. Ames No. 65062); Machu Picchu, at 2040 meters altitude, rocky slope, January 9, 1946, *C. Vargas 5551*.

**Epidendrum longirepens** (*C. Schweinf.*) *C. Schweinfurth comb. nov.*

*Epidendrum Schlechterianum* Ames var. *longirepens* C. Schweinfurth in Bot. Mus. Leafl. Harvard Univ. 11 (1943) 115.

Renewed study of the plant which I described as *Epidendrum Schlechterianum* var. *longirepens* has convinced me that this concept is worthy of specific rank. While it certainly is allied to *E. Schlechterianum*, this entity is widely divergent by reason of its long creeping rhizome, its very small leaves, its petals which are nearly or quite as broad as the sepals (not markedly narrower) and its lip which is rounded or only slightly (not deeply) cordate at the base.

**Epidendrum pachychilum** *Kränzlin* in Fedde Repert. 1 (1905) 184.

*Epidendrum aquaticoides* C. Schweinf. var. *pusillum* C. Schweinfurth in Bot. Mus. Leafl. Harvard Univ. 11 (1943) 82.

Recent study of material referable to *Epidendrum pachychilum* shows that this concept differs in certain respects from the original description.

Examination of a photograph of the type of *E. pachychilum* shows that the floral bracts are rather conspicuous and triangular-ovate, not "subnullae" as described. Moreover, the sepals appear to be ovate-elliptic, rather than "oblonga" as noted. In the specimens examined, the somewhat immature flowers have sepals only about 8–9 mm. long, rather than 10 mm. long as described.

It now appears that the concept previously described as *Epidendrum aquaticoides* C. Schweinf. var. *pusillum* is referable to *E. pachychilum*.

PERU: Cuzco, Prov. of Urubamba, near Wenner Gren ruins, at 3400–3600 meters altitude, in open soaking sphagnum bog with much fog and rain, perianth fleshy, orange with faint red on outside of sepals, August 5–6, 1942, *R. D. Metcalf 30575;* On trail from Puyupata to Sayacmarca, epiphytic, at 3600 meters altitude, August 5, 1942, *C. Vargas 2894* (TYPE of *E. aquaticoides* var. *pusillum*); Same data, at 3650 meters altitude, June 23, 1948, *C. Vargas 7257*.

**Epidendrum refractoides** *C. Schweinf.* var. **humile** *C. Schweinfurth var. nov.*

Herba statura minore et pedunculi spatha unica vel nulla, et inflorescentia racemosa (non paniculata) et labelli lobo medio magis separato a specie differt.

Plant small, stout, epiphytic, up to about 19 cm. high. Stems (sometimes decumbent and rooting at base), stout, entirely concealed by imbricating leaf-sheaths or the fibers of sheaths, about 10 cm. long. Leaves apparently eleven or less, approximate, elliptic-ovate, obtuse to rounded at the apex, amplexicaul at the sessile base, up to 5.1 cm. long and 2.5 cm. wide (next to the uppermost blade largest), ascending-spreading. Inflorescence solitary, terminal, erect, about 9.5 cm. or less tall; peduncle short, about 4 cm. or less long, usually bearing a conspicuous, conduplicate, erect spathe about 2.5 cm. long; raceme rather loosely several- (7- or more) flowered, with the rachis about 6 cm. or less long. Floral

bracts lanceolate, acuminate, somewhat exceeding half of the glabrous pedicellate ovary. Flower rather small, subfleshy, greenish yellow. Dorsal sepal lanceolate-elliptic or elliptic-oblanceolate, complicate and apiculate at the apex, about 11–12.2 mm. long and 4.9–5 mm. wide, 3-nerved. Lateral sepals obliquely and broadly lanceolate-elliptic, acute, dorsally carinate, obliquely inserted at the base of the column, about 11–12.5 mm. long on the posterior margin and 5.1 mm. wide. Petals linear-oblanceolate or oblanceolate, obtuse or subacute, slightly oblique, 1- or obscurely 3-nerved, about 10.1–11 mm. long and 3 mm. wide. Lip adnate to the column up to its apex; lamina 3-lobed with the lateral lobes upcurved, cordate at base, about 6–6.5 mm. long in the center and 8–10.2 mm. wide across the lateral lobes when expanded; lateral lobes suborbicular-oval, with irregular or lobulate margins; mid-lobe distinct, elliptic-subquadrate, truncate and lightly retuse in front, with the center longitudinally thickened; disc at base with a pair of prominent complanate obliquely semiobovate calli. Column short and stout, dilated above in front, about 6.5–7 mm. high at the back.

PERU: Apurimac, Prov. of Abancay, "bosques de Ampay," epiphyte, July 1938, *C. Vargas 2050* (TYPE in Herb. Vargas).—Cuzco, Prov. of Calca, in the vicinity of the town of Lares, on rocks at 3200 meters altitude, "leaves purple," August 30, 1934, *C. Vargas 3618*.

**Epidendrum Schlimii** *Reichenbach filius* in Linnaea 22 (1849) 838; Lindley Fol. Orch. Epidendrum (1853) 64, no. 201, non *E. Schlimii* Lindley Fol. Orch. Epidendrum (1853) 74, no. 234.

*Epidendrum tenellum* Lindley Fol. Orch. Epidendrum (1853) 44, no. 138.

The identity of the concept *Epidendrum tenellum* with the earlier *E. Schlimii* has already been pointed out by Reichenbach f. in Walp. Ann. 6 (1862) 361.

The Peruvian collection cited below agrees well with *E. Schlimii* and thus extends the known range of this species from Venezuela. In this collection the flexuous inflorescence consists of remote abbreviated racemes and is thus to be described as a panicle.

Peru: Huánuco, Muña, at about 2150 meters altitude, epiphyte, May 23–June 4, 1923, *Macbride 3966*.

**Epidendrum Schlimii** *Reichb.f.* var. **gracillimum** (*Reichb.f. & Warsc.*) *C. Schweinfurth comb. nov.*

*Epidendrum gracillimum* Reichenbach filius & Warscewicz in All. Gartenz. 22 (1854) 314.

Judging by a record of *Epidendrum gracillimum* from the Reichenbach Herbarium in Vienna and by a Peruvian collection (*Vargas 3268*) which is referable to this concept, this entity appears to be merely a variety of *E. Schlimii*. It has stems (including the rachis of the inflorescence) about 10–19 cm. tall, while those of *E. Schlimii* are about 10 cm. or less tall. The leaves are commonly about 4.5 cm. or more long, whereas those of *E. Schlimii* appear to be about 3.4 cm. or less in length. The inflorescence of *E. gracillimum* has distinct and relatively elongate branches, contrasted with the abbreviated and congested branches of *E. Schlimii*. A more significant discrepancy resides in the lip which is strictly simple in *E. Schlimii* and is distinctly 3-lobed with a short transverse bilobed mid-lobe in typical *E. gracillimum*. *Vargas 3268*, however, while otherwise coinciding with the type of the latter concept, has a lip which is simple with irregular margins or is very obscurely 3-lobed.

Peru: Cuzco, Prov. of Convención, "alturas de Pintobamba," at 2300 meters altitude, epiphyte, in small damp forest, perianth pink, March 3–4, 1943, *C. Vargas 3268*.

**Epidendrum subreniforme** *C. Schweinf.* var. **ramosum** *C. Schweinfurth var. nov.*

Herba caule pluribus cum ramis strictis, foliis longiori-

bus, floribus minoribus roseo-purpureis cum labello exapiculato a specie differt.

Plant with stem consisting of several short strict branches, entirely concealed by tubular sheaths which bear leaves except at the base of the branches. Leaves elliptic or oblanceolate-oblong, acute, sessile at the cuneate base, up to 6.5 cm. long and 1.9 cm. wide. Inflorescence about 3.5 cm. long, erect and shortly recurved at the apex; peduncle about 2 cm. long, bialate, with one small infundibuliform bract; raceme loose, 5-flowered, with a fractiflex rachis. Flowers rather large, rose-purple, with spreading segments. Dorsal sepal elliptic, acute, minutely apiculate, 5-nerved, 1.5 cm. long, about 5.7 mm. wide. Lateral sepals semielliptic or obliquely elliptic-lanceolate, acute, 5-nerved, with a deep keel near the apex, about 1.53 cm. long and 6.1 mm. wide near the middle. Petals linear-oblanceolate, oblique, subacute to obtuse, about 1.43 cm. long and 3.2 mm. wide above. Lip much larger than the other segments, adnate to the column up to the apex of the latter; lamina simple or nearly so, semiorbicular-reniform, very slightly indented or subretuse in the middle of each side, narrowed above to a broad subtruncate and lightly retuse apex, without any apicule, ecallose, deeply cordate at the base, about 1 cm. long in the middle and 2.3 cm. wide. Column short, stout, much dilated above in front, about 8 mm. long at the back, extended on each side into an obliquely semiorbicular auricle.

PERU: Cuzco, Prov. of Convención, Sahuayaco, epiphyte at 1600 meters altitude, January 17, 1947, *C. Vargas 6295* (TYPE in Herb. Ames No. 63449).

**Epidendrum vincentinum** *Lindley* in Hook. Journ. Bot. 3 (1841) 88, 309, t. 11; Cogniaux in Urban Symb. Antill. 6 (1910) 526.

*Epidendrum serricardium* Schlechter in Fedde Repert. Beih. 19 (1923) 218.

This concept, which was originally described from St. Vincent, was reported by Cogniaux (l.c.) from Guadeloupe, Dominica and Martinique. It was subsequently found on Trinidad by W. E. Broadway and very recently was collected on the lower slopes of Mt. Britton, Toquillo, Puerto Rico by D. S. Correll and H. F. Winters.

A surprising extension of range is shown by a Peruvian collection of *E. vincentinum* from Cuzco, Province of Paucartambo (*C. Vargas 006793*).

The Costa Rican *Epidendrum serricardium* is obviously reducible to this concept, the description being almost an exact counterpart of that of *E. vincentinum*.

The flowers of all the material examined, whether from the West Indies, Costa Rica or Peru, appear to be somewhat larger than those described for *E. vincentinum* and the disc of the lip appears to have commonly one to three more or less distinct keels. The color of the flowers varies from pale green or greenish yellow, often tinged with bronze, to russet or mahogany-red and pale yellow, and the leaves are sometimes noted as violet or purple.

**Dichaea muricata** (*Sw.*) *Lindl.* var. **maculata** (*Poepp. & Endl.*) *C. Schweinfurth comb. nov.*

*Dichaea maculata* Poeppig & Endlicher Nov. Gen. ac Sp. 2 (1838) 3, t. 105, figs. 1–6; Cogniaux in Martius Fl. Bras. 3, pt. 6 (1906) 489.

The concept *Dichaea maculata*, which is limited to Peru, has been considered to be amply distinct from *D. muricata*, which was originally described from the West Indies, for two reasons. First the leaves of *D. maculata* are seen to be distinctly ciliolate near the apex, whereas those of *D. muricata* appear to be entire or nearly so at the apex. Secondly, the lip of *D. maculata* was described and figured as provided with a relatively long linear claw with the lamina rounded in front, while the lip of *D.*

*muricata* is only shortly clawed or has a cuneate base with the lamina distinctly acute or apiculate in front.

The first character (that of the ciliation of the leaves) is apparently a stable feature, the leaves of the Peruvian material referred to *D. maculata* being always more or less ciliolate on close examination, whereas those of the specimens referred to *D. muricata* appear to be almost invariably entire.

On the other hand, the Peruvian specimens which have these ciliolate leaves have a lip which varies from short-clawed to elongate-cuneate at the base and the apex of the lamina is invariably apiculate (sometimes with a rounded forward margin) or even sharply acute.

It seems, therefore, that the lip of *D. maculata* is rather polymorphic (as it is in typical *D. muricata*), but it appears probable that it is always more or less strongly apiculate—a character that may readily have been overlooked in the typical specimen. Since, however, this concept was described and figured with a linear-clawed lip, it may be well to recognize this tendency.

For purposes of simplification in these closely allied concepts, therefore, it seems reasonable to consider *D. maculata* as a variety of the older concept *D. muricata* (based on *Cymbidium muricatum* Sw.) of which an excellent description and floral analysis is given in Fawc. & Rendle Fl. Jam. 1 (1910) 137, t. 30, figs. 22–25. Thus we segregate var. *maculata* as having leaves with a ciliolate apical portion and a lip which is either long- and narrowly clawed or with a narrowly cuneate base.

**Dichaea panamensis** *Lindley* Gen. & Sp. Orch. (1833) 209; Kränzlin in Engler Pflanzenr. IV, 50 (Heft 83)(1923) 51.

*Epithecia panamensis* Schlechter in Orchis 9 (1915) 25.

*Dichaeopsis panamensis* Schlechter in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 519.

This variable species, heretofore recorded only from Mexico and Central America to Panama, has recently been identified from Colombia and Peru.

The latter specimen consists of a caespitose plant of eight highly variable stems, the longest of which is about 24 cm. in length—longer than any before noted by me. The leaves, also, are longer than usual, being up to 4 cm. long. The blades seem to be indistinctly, if at all, glaucous (as in the usual form). The flower, however, is much smaller than usual, but has segments closely similar to those of the typical plant.

PERU: Junín, east of Quimirí Bridge, near La Merced, at 800–1300 meters altitude, epiphyte in dense forest, sepals green, June 1–3, 1929, *E.P. Killip & A.C. Smith 25412* (U.S. Nat. Herb. No. 1359631).

**Campylocentrum Ulaei** *Cogn.* var. **peruvianum** *C. Schweinfurth var. nov.*

Herba foliis minoribus, labello paullo diverso atque calcari majore U-formi a specie differt.

Plant small, slender, epiphytic. Stem slender, about 4.5 cm. long in the specimen, entirely concealed by loose conduplicate leaf-sheaths, lightly arcuate, producing below elongate fibrous roots. Leaves several, distichous, widespreading, small, narrowly lanceolate to narrowly elliptic-oblong, narrowed to a minutely and commonly obliquely bilobed apex, slightly contracted to a sessile base, up to 2.1 cm. long and 5 mm. wide. Inflorescences lateral, racemose, much exceeding the leaves, puncturing the middle of the leaf-sheaths, densely many-flowered, up to about 6.5 cm. long, glabrous; peduncle filiform, up to 1.6 cm. long. Flowers very small, with membranaceous subparallel segments. Dorsal sepal linear-lanceolate, subacute, 1-nerved, about 2.3 mm. long and 0.8 mm. wide. Lateral sepals subequaling the dorsal sepal, narrowly and obliquely triangular-lanceolate, acute or acuminate

with a complicate apex. Petals triangular-lanceolate, acute or acuminate, slightly shorter than the sepals. Lip conspicuously spurred; lamina tubular-involute in natural position, ovate-lanceolate in outline when expanded, about 2 mm. long, deeply 3-lobed below the middle; lateral lobes relatively short, obliquely subquadrate and slightly dilated above with an obtuse outer tip; mid-lobe much protuberant, narrowly lanceolate-triangular, long-acuminate; spur relatively large, U-shaped when viewed from the side, slender and cylindric below, laterally flattened and dilated above, about 1.3 mm. long from the rounded apex to the base of the curve. Column minute. Ovary glabrous.

This plant is very similar to typical *Campylocentrum Ulaei* Cogn., but differs in having much smaller leaves, a differently proportioned lip and a larger U-shaped spur.

PERU: Junín, Chanchamayo Valley, at 1800 meters altitude, October "1924–1927," *Carlos Schunke 520* (TYPE in Herb. Field Mus. 571579).

# BOTANICAL MUSEUM LEAFLETS
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# STUDIES IN THE GENUS HEVEA VII


BY

RICHARD EVANS SCHULTES[1]


IN the course of my studies towards a monograph of the genus *Hevea*, isolated but significant observations frequently accumulate. In order that these data may be available before the completion of a final monograph, I have initiated a series of articles in which the results of field and herbarium investigations may be published. This paper continues the series and consists of miscellaneous taxonomic, nomenclatorial, phytogeographical, historical and chemical notes.

The herbarium studies herein reported were carried out in 1950, during my visits to important European botanical centers.

The chemical examinations were made by chemists in the United States Department of Agriculture and at the National Bureau of Standards on rubber samples which I secured in the Amazon from trees the identity of which was established and has been authenticated through herbarium specimens.


[1] Botanist, Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Research Fellow, Botanical Museum of Harvard University.

## 1. *Notes on the specimens of Hevea in the De Candolle Herbarium*

Although there are larger and more comprehensive collections of *Hevea* in several European and American herbaria, it is true I think, that one of the most uniquely significant is contained in the De Candolle Herbarium in the Conservatoire Botanique in Geneva.

The intensive and extensive field studies and collections which Richard Spruce carried out a century ago in the Amazon Valley laid the first solid foundation for our understanding of the genus of the commercial rubber tree. Bentham's critical treatment of Spruce's material set the pace for later taxonomic work in the group. But the first attempt at a monographic synopsis of *Hevea* was that of Mueller of Aargau, working in Geneva.

Notwithstanding the fact that Mueller had access to a number of collections of *Hevea* in the Delessert Herbarium in Geneva and in other European institutions, we may regard the specimens preserved in the De Candolle Herbarium as representing the core of his study material. These were, in large part, the basis of his treatment of *Hevea* in De Candolle's Prodromus 15, pt. 2 (1866) 717–719. Partly because of this association, the specimens and Mueller's handwritten annotations which some of them bear are worthy of special attention. Few of the specimens are rare; on the contrary, most of them are Spruce collections and are rather well distributed amongst the major herbaria of the world. This in itself is an additional reason for a close examination of those sets which have been, in a way, authenticated by the work of that great master of the *Euphorbiaceae*.

The arrangement of the species in the De Candolle Herbarium follows the order of their publication in the Prodromus. Thus, the material of *Hevea* can be found

in the order in which the species are enumerated in the Prodromus 15, pt. 2 (1866) 717–719. In this article, I have followed Mueller's subgeneric division of *Hevea* into *Bisiphonia* and *Euhevea*, now no longer accepted, and I have employed the binomials used by Mueller regardless of the modern status of these names. This I have done so that the following notes will correspond with the arrangement of the material in the De Candolle Herbarium. In each case, however, I have indicated the annotation which I made in June 1950, so that there should be no difficulty in finding the present-day equivalent of the older binomials in those few cases where there has been some change. I wish to thank Dr. Charles Baehni, Director of the Conservatoire Botanique and other members of this institution for their kind help during my visit in June 1950.

## Bisiphonia

**Hevea Spruceana** (*Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

*Siphonia Spruceana* Bentham in Hooker's Journ. Bot. 6 (1854) 370.

There is one specimen under *Hevea Spruceana*, a duplicate type.

Brazil: Estado do Amazonas, Rio Amazonas, "In vicinibus Santarem, Prov. Pará. Coll. *R. Spruce*, Jul. 1850." [This date, printed, has been altered to read "1851."]

**Hevea discolor** (*Benth.*) *Mueller-Argoviensis* in De Candolle Prodr. 15, pt. 2 (1866) 717.

*Siphonia discolor* Bentham in Hooker's Journ. Bot. 6 (1854) 369.

There are three specimens under this name, including a duplicate type of the species. I have annotated all three as *Hevea Spruceana*.

Brazil: Estado do Amazonas, Rio Solimões, near Ega [now called Teffé] [fide Mueller in Prodr. 717, no. 2] 1834, *Poeppig 2595*.

Consisting of several leaves and flowering inflorescences, this specimen is labelled "Perou! *M. Poeppig* 1834." In a small envelope containing flowers, there is a label "2595." For our information that the specimen was collected "prope Ega," we are indebted to Mueller, for there is no indication on the sheet that this was its locality. In fact, it is very probable that the concept represented by *Poeppig 2595* does not occur in Peru, for it has apparently never been found in that country (cf. Seibert in Ann. Mo. Bot. Gard. 34 (1947) 261). Teffé (or Ega) represents almost the westernmost extent of *Hevea Spruceana*.

Brazil: Estado do Amazonas, Rio Negro, "de vicinibus Barra [now called Manáos], Prov. Rio Negro. Coll. *R. Spruce*. Dec.-Mart. 1850–51."

Originally determined as "*Siphonia elastica* Pers. !," this collection represents that expression of *Hevea Spruceana* which is most abundant near the mouth of the Rio Negro. It is in fruit and has several beautiful seeds very typical of the *Hevea Spruceana* of the Manáos area: long, considerably flattened, with two very conspicuous flat surfaces ventrally, almost diamond-shaped in cross section, measuring 35 mm. long, 12 mm. thick, 17–18 mm. wide. There are also a number of valves of the capsule.

Brazil: Estado do Amazonas, Rio Amazonas, "ad oram septentrionalem flum. Amazonum, ad ostium Rio Negro. Coll. *R. Spruce 1171*. Aug. 1851."

*Spruce 1171* is the type collection of *Siphonia discolor* (cf. Schultes in Bot. Mus. Leafl. Harvard Univ. 15 (1952) 253. It represents the same expression of *Hevea Spruceana* as the collection previously discussed.

**Hevea pauciflora** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 203.

*Siphonia pauciflora* Spruce ex Bentham. in Hooker's Journ. Bot. 6 (1854) 370.

There is apparently no material of this concept in the De Candolle Herbarium.

**Hevea rigidifolia** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 203.

*Siphonia rigidifolia* Spruce ex Bentham in Hooker's Journ. Bot. 6 (1854) 371.

There is one specimen of *Hevea rigidifolia*, a duplicate type.

Brazil: Estado do Amazonas, Rio Uaupés, "prope Panuré [Ipanoré] ad Rio Uaupés. Coll. *R. Spruce 2527*. Oct. 1852–Jan. 1853."

*Spruce 2527* in the De Candolle Herbarium comprises a branch with several adult and young leaves and abundant flowering material. An examination of one staminate and one pistillate flower from the collection indicates agreement with the descriptions of this concept prepared on the basis of a recent study of the type and new material (Schultes in Bot. Mus. Leafl. Harvard Univ. 13 (1948) 101, t. viii).

**Hevea Benthamiana** *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

The specimen of *Hevea Benthamiana* in the De Candolle Herbarium is apparently the type of the concept.

Brazil: Estado do Amazonas, Rio Uaupés, "prope Panuré [Ipanoré] ad Rio Uaupés. Coll. *R. Spruce 2560*.

This material comprises four or five leaves and two axes of the inflorescence. It was formerly confused with *Hevea Spruceana* and was distributed as *Siphonia discolor*, but Mueller, recognizing it as a distinct concept, described it on the basis of this specimen.

**Hevea brasiliensis** (*Willd. ex A. Juss.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

*Siphonia brasiliensis* Willdenow ex Adr. de Jussieu Euphorb. Gen. (1824) t. 12, pl. 38b, fig. 1–6.

The De Candolle Herbarium has two collections of this species, one of which is a fragment of the type.

Brazil: Estado do Pará, Rio Amazonas, "Pará *Hoffmannsegg.*"

The Hoffmannsegg material of this concept, collected probably at the mouth of the Amazon by Sieber, is that on which the earliest publication of the binomial *Siphonia brasiliensis* and Willdenow's accompanying diagnostic plate were based (cf. Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 79). The type is in the Willdenow Herbarium in Berlin; there is a duplicate type in Paris (Schultes l.c. Pl. xix). In an envelope on the sheet labelled *Hevea brasiliensis* in the De Candolle Herbarium, there are two leaflets of this Sieber collection; the envelope is marked, in Mueller's hand: "Folia: Para: Hoffmannsegg."

Brazil: Estado do Pará, Rio Amazonas, "Para, Spruce, 1849."

This second collection of *Hevea brasiliensis* consists of two complete leaves and several inflorescence axes in good flower. It is the widely distributed collection which Spruce made in the region of Belém do Pará shortly after his arrival in South America in 1849; since, in Pará, *Hevea brasiliensis* flowers in August and early September, we may assume that this collection was one of the first which Spruce, who arrived in mid-July, 1849, made in South America. It can be considered topotypical; and, indeed, it matches the type extremely well.

Mueller has written an annotation to the effect that this Spruce specimen was acquired "ex hb. Van Huerck." The Van Huerck Herbarium is incorporated in the col-

lection at the Natuurwetenschappelijk Museum in Antwerp, Belgium, where there is an excellent specimen of this Spruce collection of *Hevea brasiliensis* and where, on a Sagot collection of *H. guianensis* Aubl. from French Guiana, I found the following interesting annotation: [ex herb. DC contre un fragment de *H. brasiliensis* Muell.-Arg.].

**Hevea lutea** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

*Siphonia lutea* Spruce ex Bentham in Hooker's Journ. Bot. 6 (1854) 370.

The De Candolle Herbarium possesses two specimens which Mueller referred to *Hevea lutea*. I have annotated both as *Hevea guianensis* Aublet var. *lutea* (Spruce ex Benth.) Ducke & Schultes.

VENEZUELA: Territorio del Amazonas, Río Negro, "prope San Carlos, ad Río Negro, Brasiliae borealis. Coll. *R. Spruce 3139*, 1853–54."

*Spruce 3139* is widely distributed in the principal herbaria. The De Candolle specimen, a duplicate type of *Hevea apiculata* Baillon, is especially complete, comprising several leaves, a few loose leaflets and abundant flowering material. Mueller, who, in the Prodromus (l.c. 719), reduced *Hevea apiculata* to synonymy under *H. lutea* and who later (in Martius Fl. Bras. 11, pt. 2 (1874) 302) made it a variety of *H. lutea*, wrote on the specimen: "Non differt a *Hevea lutea* Muell.-Arg. 1863. β *apiculata* Muell.-Arg. in Flor. bras."

BRAZIL: Estado do Amazonas, Rio Uaupés, "prope Panuré [Ipanuré] ad Rio Uaupés. Coll. *R. Spruce 2088*. Oct. 1852–Jan. 1853."

The De Candolle Herbarium material of *Spruce 2088*, a duplicate type of *Siphonia lutea*, is an especially complete flowering specimen of a widely distributed number.

**Hevea guianensis** *Aublet* Hist. Pl. Guyan. 2 (1775) 871.

There are two collections in the De Candolle Herbarium which Mueller refers to this concept. I have annotated them both as *Hevea guianensis.*

FRENCH GUYANA: 1840, *Leprieur.*

The Leprieur collection, represented also at Paris, seems to be the earliest flowering material of *Hevea guianensis.* Mueller has left a label in his handwriting, which reads: "Euphorbiae. Calyx ad mediam usque 5-partitus, petala nulla, stam 5! circa rudimentum ovarii in columnam coalita, filamenta subnulla, fol. stipulata."

FRENCH GUYANA: Maroni, 1857, *P. Sagot 510.*

The Sagot collection is represented in several herbaria. The specimen in the De Candolle Herbarium is in abundant flower.

2. *Miscellaneous notes, chiefly on specimens of Hevea in various European herbaria*

**Hevea brasiliensis** (*Willd. ex A. Juss.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

BRAZIL: [Near mouth of Rio Amazonas] *Sieber* s.n. [?]

The Humboldt Herbarium in Paris has a collection referable to *Hevea brasiliensis* and consisting of one leaflet and several flowers in a little packet. The packet is labelled "*Siphonia brasiliensis W.* (e specim authent. ab ipso Willdenow misso)," and is evidently a fragment from the type specimen in the Willdenow Herbarium collected by Sieber, which it matches perfectly (cf. Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 79).

In this same herbarium, there is a full specimen which

likewise matches the type. Unfortunately, it bears no data concerning the locality or date of collection nor a collector's name, but I believe it to be a duplicate type. The only annotation it bears is the following: "dedit Willdenowius, 1811."

**Hevea guianensis** *Aublet* Hist. Pl. Guian. 2 (1775) 871.

In the Paris Herbarium, there are two sheets of *Hevea guianensis* upon which is written: "Leg. *A. Richard.* Sta. Martha Antilles. *Siphonia elastica* ex hb. de Franqueville. Herb. E. Cosson 18." The special interest attending these particular specimens centers on the locality data. The only "Sta. Martha" which I have been able to find registered for the entire Antillean area is the very old city of that name on the Caribbean coast of Colombia. The genus *Hevea*, of course, is unknown from that region, and we may very safely assume that it does not exist there in a natural state.

I believe this to be an erroneous annotation. The specimen corresponds so very closely to other material of *Hevea guianensis* from French Guiana (including specimens also collected by Richard) that I am convinced that it was collected in that colony. Louis Claude Richard, who was commissioned in 1781 to carry out explorations in French Guiana and the Antilles, spent much of his time in French Guiana, later travelling in Martinique, Guadeloupe, Jamaica, St. Thomas, and some of the islands in the Gulf of Mexico (cf. Lasègue "Musée Botanique de M. Benjamin Delessert" (1845) 474). *Hevea* is known in a native state in none of these areas except French Guiana.

**Hevea guianensis** *Aublet* var. **lutea** (*Spruce ex Benth.*) *Ducke & Schultes* in Caldasia 3 (1945) 249.

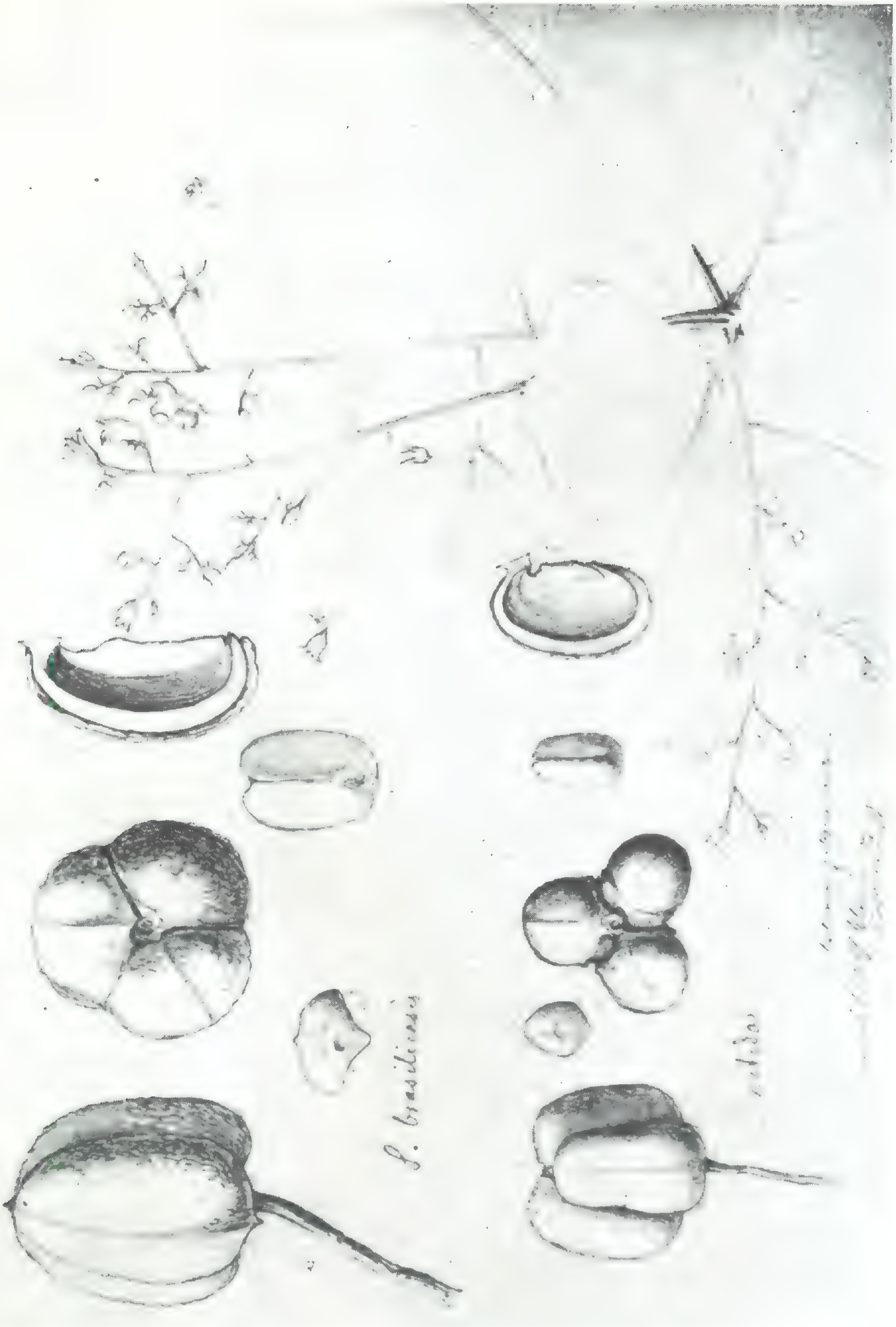
## EXPLANATION OF THE ILLUSTRATION

PLATE I. Reproduction of a page from Martius' notes, preserved in the Munich herbarium. The manuscript description of *Siphonia nitida* Martius may be seen at the top of the page. I wish to thank the officials — especially Dr. Otto Renner and Dr. Th. Suessengurth — for making available for publication this interesting historical manuscript.

## EXPLANATION OF THE ILLUSTRATION

PLATE II. Photograph of the drawing (by Martius?) of *Siphonia nitida* Martius in the herbarium of the Botanische Staatssammlung in Munich. In view of the fact that, until recently, the concept *Hevea nitida* has not been understood and that no reproduction of the fruiting portions of the type specimen has ever been published, it has seemed advisable to reproduce this drawing, with the kind permission of the officials of the Munich herbarium.

# Plate II



*Hevea andenensis* C. F. Jones "South America" (1940) 222.

In his book "South America," Clarence F. Jones has published what would appear to be a *nomen nudum*—*Hevea andenensis*—in a passing reference to the source of Peruvian rubber. Although this publication can in no way be considered as a natural history and although no specimens were cited, the binomial may be picked up by some of the many non-technical writers who are presenting works on various studies in Latin American affairs. In order to preclude any confusion which might result from the perpetuation of the *nomen nudum*, the present note appears to be advisable.

We are not certain, of course, as to the exact concept which Jones had in mind when he used the binomial. Jones speaks of the plant as growing at a high altitude. Seibert (in Ann. Mo. Bot. Gard. 34 (1947) 293) states that "*Hevea guianensis* in pure strain appears to have been collected rarely in Perú" but (l.c. 294) that *H. guianensis* var. *lutea* "is a characteristic tree of the Peruvian *montaña*" and "is found on much of the Peruvian *tierra altura* [sic] and hilly land of the Peruvian Amazon basin . . . on the eastern Andean foothills, occasionally as high as 5000 feet." In view of this, I believe that we are justified in referring *Hevea andenensis* to *H. guianensis* var. *lutea*.

It is possible that Jones' binomial is an incorrect rendering of another *nomen nudum*—*Hevea andinensis* Sperber (in Tropenfl. 14 (1910) 96)—but there is no evidence that this is the case.

**Hevea nitida** *Martius ex Mueller-Argoviensis* in Martius Fl. Bras. 11, pt. 2 (1874) 301.

Brazil: "In silvis secundum fl. Solimões et Amazonicum" [1819], *Martius s.n.*—"Prov. do Alto Amazones. In silvis secundum. Solimões

et Amazonum'' [1819] *Martius s.n.*—''In silvis Japurensibus'' [1820], *Martius s.n.*

In the herbarium in Munich, there are four Martius specimens of *Hevea nitida*, but only three different labels for the four specimens. Since the collections are not numbered, we cannot say whether or not Martius made three collections or merely one as has hitherto been presumed. After a study of the material in Munich, I am inclined to believe that there are two distinct collections; one, represented by three specimens, from the Rio Amazonas somewhere above the mouth of the Rio Negro (which section of the Amazon is known in Brazil as the Rio Solimões); the other, represented by a single specimen, from the Rio Japurá. We know that this highly local species is found on both rivers in localities where Martius collected: São Paulo de Olivença (on the Solimões); La Pedrera or Cupatí (on the Japurá).

In 1930, Dr. Francis Macbride of the Field Museum photographed type specimens in Europe. His photograph No. 6631 represents a specimen of the second ''collection'' cited above. In the middle of the last century, the type concept was not a guiding principle of taxonomy and Martius undoubtedly based his description on more than one specimen. If we are to choose a type, however, I should elect one of the two specimens which I have cited above as the first ''collection.'' One of these specimens seems to have been awarded more attention by Martius and Mueller than the others, for Martius wrote on it: ''*Siphonia nitida* Mart.'' and Mueller annotated it as ''*Hevea nitida* J. Muell.'' The other specimens are not so annotated. Furthermore, for this specimen there are seeds and capsules in the fruit collection. For these reasons, then, I have labelled this specimen and not the one represented by Macbride's photograph as the type.

There is in the Munich Herbarium an unfinished draw-

ing of *Hevea nitida*. Whether or not this drawing was executed by Martius himself or merely under his direction, I have not been able to ascertain. Since it is unfinished, it has hitherto never been published (Plate II).

Other specimens of the Martius collection(s) of *Hevea nitida* are found in the Herbarium Delessert in the Conservatoire Botanique in Geneva and in the Rijksherbarium in Leiden. The Geneva specimen bears the following information: "Solimões et Amazonium fluv." The Leiden material is labelled "Brasilia pr. Rio Negro" and was acquired by exchange from the Munich Herbarium. There is an unusually complete set of Martius plants in Brussels, but I found no specimen of *Hevea nitida* there.

*Hevea nitida* was, for many years, surrounded by much uncertainty. Ducke (in Arch. Inst. Biol. Veg. Rio Janeiro 2 (1935) 243) and Schultes (in Bot. Mus. Leafl. Harvard Univ. 12 (1945) 7) each held different opinions. In 1947, using new characters which he found very useful in the study of *Hevea*, and on the basis of Macbride's photograph, Seibert (in Ann. Mo. Bot. Gard. 34 (1947) 298) maintained that *Hevea nitida* and *H. viridis* Hub. were identical and reduced the latter to synonymy under the former. Schultes (in Bot. Mus. Leafl. Harvard Univ. 13 (1947) 10 and Baldwin (in Journ. Hered. 40 (1949) 48) accepted Seibert's change. It is apparent from my examination of the Martius material that Seibert's opinion is correct. Not only do all of the vegetative characters of *Hevea nitida* correspond exactly with those given for *H. viridis;* the seeds and capsules which are preserved in Munich alone furnish sufficient evidence that *H. nitida* is the same concept which has been masquerading under the name *H. viridis*.

**Hevea pauciflora** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 203.

*Siphonia Kunthiana* Baillon Étude Gén. Euphorb. (1858) 326.

VENEZUELA: [Upper Orinoco basin, 1800], *Bonpland 5022.*

The type of *Siphonia Kunthiana* in the Humboldt Herbarium in the Musée d'Histoire Naturelle in Paris is sterile, consisting of but three leaflets. The tip of only one of the three is preserved, but it shows the calloused glandular tip which is characteristic for the species. The longest leaflets measure 22–24 cm. long, 7.5–8 cm. wide. They are elliptic, long-acuminate and very membranaceous.

DUTCH GUIANA: Boschreserve, Sectie O, Boomnummer 41, November 10, 1916, *Forestry Bureau 2368.*

FRENCH GUIANA: 1857, *P. Sagot* (pro parte).

In Paris, there are two sheets marked "Hb. Sagot 510" and they represent different concepts. One, labelled "Maroni, ile portal 1857," is undoubtedly *Hevea guianensis;* but the other has larger leaflets of a different shape, with the glandular-calloused tip and the type of scales on the lower surface which are so characteristic of *H. pauciflora.*

I think that we may safely refer this second specimen, even though it be sterile, to *Hevea pauciflora*, and I have so annotated it. It bears the annotation "Hb. Sagot 510. Le caoutchouc. Acarouany. (Guyana fraise. 9e 1854, in silvis humidis.) *P. Sagot.*"

This is not the first time the identity of the specimen in question has been the subject of discussion. A letter from Dr. P. J. S. Cramer, dated March 3, 1913, is attached to the specimen. It states: "This specimen differs much from the others which show well the characteristics of *Hevea guyanensis* (obtuse leaf, rounded buds). The leaflets approach most closely *Hevea brasiliensis* . . . It

seems to me that the reason may be that this specimen was collected from a young plant; the texture of the leaves also indicates this. On all young plants one finds near *Hevea guyanensis*, the typical characters do not appear; they also have leaves characteristic of *Hevea brasiliensis*."

Credit must go to Cramer for his perspicacity, but the suggestion that the specimen is referable to *Hevea brasiliensis* cannot be accepted in view of the characters exhibited in the tip and scales.

This is apparently the first time *Hevea pauciflora* has been recorded for the flora of French Guiana. Hitherto, the only species known from that colony was *Hevea guianensis*.

Similarly, till now *Hevea pauciflora* has never been reported from Dutch Guiana, although it is not uncommon in adjacent British Guiana. I have found a Surinam specimen in the herbarium at Utrecht which seems to represent this species. It is sterile, but the tip of the leaflet shows it to belong to *Hevea pauciflora*, not to *H. guianensis*.

**Hevea pauciflora** (*Spruce ex Benth.*) *Mueller-Argoviensis* var. **coriacea** *Ducke* in Arch. Inst. Biol. Veg. Rio Janeiro 2 (1935) 239.

British Guiana: August 1843, *Richard Schomburgk 1381*.

The specimen of this collection which is preserved in the Humboldt Herbarium in Paris was annotated with an unpublished name in *Siphonia* honoring Schomburgk. The annotation seems to have been made prior to 1865, for since that year the generic name *Hevea* has been universally accepted by all who have worked seriously with the group. I was unable to ascertain in whose handwriting the annotation was written. It is significant in being

apparently the earliest recognition of this distinct concept, antedating Hemsley (*Hevea confusa*) and Ducke (*H. paucijlora* var. *coriacea*) by many years (cf. Schultes in Bot. Mus. Leafl. Harvard Univ. 15 (1952) 264.

**Hevea rigidifolia** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 203.

Colombia: Comisaría del Vaupés, Río Guainía basin, Río Naquieni, at base of Cerro Monachí. Caatinga forest. June 1948, *Richard Evans Schultes & Francisco López 10112;* Same locality and date. *Schultes & López 10118, 10119, 10120, 10122, 10130.*

This most unusual species of *Hevea,* recently rediscovered after the passing of a century (cf. Schultes in Bot. Mus. Leafl. Harvard Univ. 13 (1948) 97), has hitherto been thought to occur only in Brazilian territory. It was naturally to be expected in adjacent regions of Colombia and was so indicated in an enumeration of species of *Hevea* in Colombia in 1945 (Schultes in Bot. Mus. Leafl. Harvard Univ. 12 (1945) 11).

Recent explorations in the upper Río Negro basin indicate that *Hevea rigidifolia* is rather widespread in a number of the affluent rivers of the right bank from the Río Curicuriarí northwards. It is extremely abundant in many of the caatingas of this region. Phytogeographically most noteworthy was the discovery of the species far upstream in the basin of the Río Guainía, at the base of the Cerro Monachí mass, in Colombian territory. The proximity of this locality to Venezuela would suggest the strong possibility that *Hevea rigidifolia* may also form a component of the caatinga forests of the Venezuelan Territorio del Amazonas. The discovery of *Hevea rigidifolia* in Venezuela would indeed be significant, as most of the waters drain into the upper Orinoco system instead of the Amazon.

**Hevea Spruceana** (*Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

In Everard im Thurn's widely consulted book "Among the Indians of Guiana" (1883) 238, it is stated "one tree thus attractive [seed used as bait] to fish is the Hatie 'india-rubber' plant (*Hevea Spruceana*)." It would seem advisable to point out that *Hevea Spruceana* has never been collected in the Guianas and is known only in the Brazil Amazonia along the Amazon River itself below the mouth of the Putumayo (Içа) and along the lower course of its affluents.

In these earlier years, there was much confusion between *Hevea Spruceana* and *H. pauciflora* (Spruce ex Benth.) Muell.-Arg. An attempt to clarify this confusion led me, during my stay at the Royal Botanic Gardens, Kew, in 1950, to the discovery of several points of bibliographic interest which, since they are apparently not widely known, would seem to bear discussion and repetition in this series of miscellaneous notes on *Hevea*.

The confusion between *Hevea pauciflora* and *H. Spruceana* in British Guiana began in 1881 when Oliver (in Kew Rept. 1880 (1881) 37), assuming, for some unstated reason, that the inflorescences of the type material of *H. pauciflora* were abnormal, stated categorically that this concept is referable to *H. Spruceana* and that all of Jenman's collections likewise represented *H. Spruceana*. Oliver (l.c.) reported that this rubber had the following native names in British Guiana: Arawak—*haatie;* Carib —*po-muy;* Ackawoi—*sibisibi.*

G. S. Jenman, through whose extensive collections we know *Hevea pauciflora* var. *coriacea* as it occurs in British Guiana, took up Oliver's identification of his material as *H. Spruceana.* In his fascinating article entitled "A journey in search of 'Hevea Spruceana' with remarks on India rubber and gutta percha yielding plants

generally" (in Timehri 1 (1882) 44), Jenman quoted Oliver as follows: "With regard to the Heveas sent by Mr. Jenman (No. 621 and 725), I have examined them carefully and believe they both belong to the same species, and that they are identical specifically with *H. pauciflora* Muel. Org. [sic] *Siphonia pauciflora*, Bnth.) and *H. Spruceana* Muel. Org. (*Siphonia Spruceana* Bnth.). Of these two names, the latter should be adopted —the type specimen of *H. pauciflora* being evidently abnormal as to the inflorescence, and the plant flowering in copious panicles . . . The name to adopt here is *Hevea Spruceana* Muel. Org. This satisfactorily settles the identity of the plant."

These rubber trees were later described by Hemsley (in Hooker Ic. Pl. 6 (1898) t. 2570, t. 2575, figs. 1–3, 12–13) as *Hevea confusa*. As a synonym of *Hevea confusa*, he included "*H. Spruceana* Oliv. in Timehri, 1882, p. 50, non Muell.-Arg." It should be pointed out that, in reality, there is no *Hevea Spruceana* of Oliver, for Oliver himself definitely stated that he believed the specimens to represent *H. Spruceana* of Mueller-Argoviensis; the problem is nothing more than a mere misidentification of material.

Farther on in his book, Jenman (l.c. 51) offers an excellent ecological note on this *Hevea:* "They are very plentiful. The situation is a tract of low alluvial land along the bank of the river, which in the rainy season is quite submerged, often apparently deeply . . . The forest was high and dense, producing a gloomy shade within, and there was little undergrowth. The Hevea was scattered irregularly among other subjects. The plants varied much in size; the largest observed and measured did not exceed 18 to 21 inches in diameter, or from 40 to 60 feet in height. As a natural result of confinement in dense forest, the trunks were here straight and unbranched,

## EXPLANATION OF THE ILLUSTRATION

PLATE III. HEVEA MICROPHYLLA *Ule*. Photograph of the tree (*Schultes & López 9593*) from which the leaf and bark material for the chemical analysis reported in this paper were collected.

*Photograph by* RICHARD EVANS SCHULTES

# Plate III

## EXPLANATION OF THE ILLUSTRATION

PLATE IV. A view of the caatinga at Taracuá, Rio Uaupés, Brazil, showing the abundance of *Hevea rigidifolia* (slender, columnar trees without buttress roots in center and background). These trees were tapped for rubber, the analysis of which is reported in the present article.

*Photograph by* RICHARD EVANS SCHULTES

# Plate IV

but on the banks of the river and creeks, a situation they seem to prefer, they are branched, much stouter and hardly erect, but lean out in the center, in the effort to steer clear of their close-growing neighbors . . . September is the flowering season, and April and May is, I think, the fruiting season."

3. *Notes on chemical analyses of* **Hevea rubber samples**

**Hevea Benthamiana** *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

COLOMBIA: Comisaría del Amazonas, Río Cotuhé, near its mouth, near Tarapacá. "Small tree, basally swollen, tapering rapidly upwards. Bark externally dark brown, smooth; internally red; thin, peeling easily from cambium. Latex white, abundant. Leaflets reclinate. Flowers yellow, some bright red in lower half of calyx. *Seringa chicote.*" September 8, 1946, *Richard Evans Schultes 8123.*—Río Putumayo, Tarapacá. "Leaflets strongly reclinate. Trunk 65 feet tall; basally swollen, 17 inches in diameter, rapidly tapering upwards. Bark very smooth, 5 mm. thick, soft, externally dark brown, internally reddish. Crown compact, heavy. Flowers yellow, reddish at base. Latex white, of medium thickness." September 9, 1946, *Richard Evans Schultes 8125.* Same locality and date, *Schultes 8126, 8127.*

A sample of smoke-cured rubber taken from an estrada of trees at Rapidol, on the left bank of the Río Putumayo at Tarapacá in Amazonian Colombia has been analyzed by Mr. A. V. McMullan of the Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, with the following results: "Resins (acetone extract) 2.60%; Rubber hydrocarbon (benzene extract) 92.99%; Insolubles 4.41%; Comments on character of dried benzene extract: Tough, strong and hard, similar to *brasiliensis.*

In the short-lived exploitation of wild rubber in Amazonian Colombia during the past war, rubber from the vicinity of Tarapacá was purchased by the Rubber Development Corporation as the equivalent of "Up-River" (a relatively high grade of *Hevea brasiliensis* rubber).

I have examined several hundred trees in the estradas which produced the sample analyzed and have found that they represent rather typical *Hevea Benthamiana*. There is no *Hevea brasiliensis* in the Putumayo watershed.

**Hevea guianensis** *Aublet* var. **lutea** (*Spruce ex Benth.*) *Ducke & Schultes* in Caldasia 3 (1945) 249.

Brazil: Estado do Amazonas, Rio Negro near mouth of Rio Issana. April 7, 1948, *Richard Evans Schultes & Francisco López 9784A*.

In the upper Rio Negro basin, very little exploitation of *Hevea guianensis* var. *lutea* has been carried out because of the great abundance of *H. Benthamiana* which is preferred. An analysis of air-dried scrap from the tree represented by *Schultes & López 9784A* gave the following results: "Resin (acetone extract) 4.97%; Rubber hydrocarbon (benzene extract) 86.42%; Insolubles 8.61%; Softer, less strong and tough in comparison to *brasiliensis*." An analysis of the bark from this tree gave the following results: "Resin (acetone extract) 1.34%; Rubber hydrocarbon (benzene extract) 1.25%. Compares favorably with crude rubber from some species."

**Hevea microphylla** *Ule* in Engler Bot. Jahrb. 35 (1905), t. 1:j, k, l, m; in Kautschukgewinnung (Kolonialwirtsch. Kom. 1905) (1905) 10.

Brazil: Estado do Amazonas, Rio Negro, São Felipe, below mouth of Rio Issana. "Small, whip-shaped tree, basally swollen. Basal diameter 9 inches, height 40 feet. Leaflets horizontal to slightly reclinate. Latex sparse, white, thin, not easily coagulating. Bark of terminal branches red, smooth; of trunk, dark brown-red outside, whitish inside, thin, hard, peeling readily. Wood extremely soft, white. 46 rings." January 8, 1948, *Richard Evans Schultes & Francisco López 9593*.

Ample material of the bark and leaves of this tree was taken for chemical analysis. The latex of *Hevea microphylla* is, in general, extremely thin and coagulates be-

tween the fingers to a sticky mass of little elasticity. The tree is never tapped by the natives, not even for adulterating the latex of *Hevea Benthamiana*, because, according to the rubber workers, the latex of the "seringueira tambaquí" (*H. microphylla*) often acts as an anti-coagulant when mixed with that of *H. Benthamiana*.

In view of this, one result of Mr. McMullan's analysis is extremely interesting. The bark of *Schultes & López 9593* gave the following analysis: "Resin (acetone extract) 1.78%; Rubber hydrocarbon (benzene extract) 0.97%. Good rubber in comparison with *brasiliensis*." The leaves, when studied, gave the following analysis: "Resin (acetone extract) 6.83%; Rubber hydrocarbon (benzene extract) 0.81%. Typical leaf rubber, soft, tacky and weak." It would appear from this study that the composition of the latex from different parts of one individual of *Hevea microphylla* can vary rather appreciably.

**Hevea nitida** *Martius ex Mueller-Argoviensis* in Martius Fl. Bras. 11, pt. 2 (1874) 301.

Brazil: Estado do Amazonas, Rio Negro, Serrinha, opposite mouth of Rio Issana. Caatinga. January 7, 1948, *Richard Evans Schultes & Francisco López 9586*.

In several caatingas in the upper Rio Negro basin, I saw evidence that, in the rubber boom of the past war, *Hevea nitida* was cut for a few days or weeks and was then abandoned. Trees at the confluence of the Rio Negro with the Rio Uaupés and at Serrinha had from three to ten incisions. It is probable that natives, many of whom at the start of the rubber boom were unfamiliar with *Hevea nitida*, were attracted by the great density of this species in the caatinga formation and began to gather latex from it. Since the latex of *Hevea nitida* (formerly known as *H. viridis* Huber) has the reputation, not only of giving a worthless rubber, but also of "poisoning" the

latexes of other species and preventing their coagulation (Schultes in Bot. Mus. Leafl. Harvard Univ. 12 (1945) 11; Seibert in Ann. Mo. Bot. Gard. 34 (1947) 269), it is probable that the natives gave up the exploitation of their caatinga trees upon discovery of this characteristic of *H. nitida*.

Material for chemical study was taken from bark and leaves of the tree which supplied the herbarium collection *Schultes & López 9586*. The analyses of this material are as follows: Bark—"Resin (acetone extract) 2.57%; Rubber hydrocarbon (benzene extract) 0.64%. Poor, soft, sticky." Leaves—"Resin (acetone extract) 10.52%; Rubber hydrocarbon (benzene extract) 0.77%. Typical leaf rubber."

**Hevea pauciflora** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 203.

Brazil: Estado do Amazonas, Rio Negro, Carapaná (above confluence of Rios Negro and Uaupés). "Tree 55 feet tall, columnar, 18 inches in diameter. Latex light yellow, thick, coagulating to a poor rubber. Bark externally smooth, light tan-brown, inside whitish, thick, hard. Flowers borne before old leaves fall. Staminate flowers open cupuliformly, yellow but red line running up centre of sepals internally and short red lines at junctions of sepals. Leaflets thick chartaceous, horizontal. Seed valves very large." November 30, 1947, *Richard Evans Schultes & Francisco López 9194*.

At the little hamlet of Carapaná, a few kilometers upstream from the confluence of the Negro and the Uaupés, there is a small planting of trees of *Hevea pauciflora*. The collection cited above was made from this colony.

These trees were tapped and an air-dried sample of the rubber was submitted to the National Bureau of Standards in Washington for analysis. The results of this analysis are significant. Dr. Lawrence A. Wood reported (Letter and report, Dr. Lawrence A. Wood to Dr. R. D. Rands, November 7, 1949) that: "The sample was given

the rating of Grade III (fair) based on the system used at the National Bureau of Standards for grading wild rubber." (For details of this system, reference is made to Rubber Age 62 (1947) 173). Further notes in the analysis are: "Shrinkage on washing and drying 13.5%. Mooney viscosity 17.5. Resins (acetone extract) 17.1%; rubber hydrocarbon 80.4%; insoluble materials 2%." The sample, after vulcanization for 45 minutes (optimum cure) at 141°C according to the ACS II test formula, had the following tensile physical characteristics: ultimate elongation 685%; tensile strength 1885. The elongation at 200 psi was 251%.

**Hevea rigidifolia** (*Spruce ex Benth.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 203.

Brazil: Estado do Amazonas, Rio Uaupés, Taracuá. Caatinga. February 3–6, 1948, *Richard Evans Schultes 9673, 9678, 9680.*

The rubber from *Hevea rigidifolia* has the reputation of being of a very poor quality. Indeed, a rapid examination in the field can convince the investigator of the soundness of this reputation. There seems, however, to be something more complex than would appear on superficial examination. This is brought out by the unexpected results of Mr. McMullan's analysis of an air-dried sample of rubber which I obtained by tapping twenty-six trees of *Hevea rigidifolia* in the extensive caatinga behind the settlement of Taracuá on the Rio Uaupés, near the mouth of the Rio Tikié. The collections cited above are from three of the individuals which were tapped. Mr. McMullan's analysis follows: "Resin (acetone extract) 3.36%; Rubber hydrocarbon (benzene extract) 95.01%; Insolubles 1.63%. Appeared to be somewhat stronger and harder than *guianensis.*"

Brazil: Estado do Amazonas, Rio Uaupés, Ipanoré. Caatinga. February 2, 1948, *Richard Evans Schultes & Francisco López 9665.*

Samples of the bark and leaves of an individual of *Hevea rigidifolia* from Ipanoré were gathered for chemical examination. Ipanoré is the type locality of this species. It is very interesting to compare the analysis of the bark and leaf of this plant with that of the air-dried rubber specimen from Taracuá, a locality only a few miles east of Ipanoré. *Schultes & López 9665* gave the following analysis: "Bark—Resin (acetone extract) 7.85%; Rubber hydrocarbon (benzene extract) 0.00 Leaves—Resin (acetone extract) 27.16%; Rubber hydrocarbon (benzene extract) 1.28%. Poor, typical leaf rubber."

It is probable that more analyses of rubber samples taken in the field from wild populations and authenticated by identifiable herbarium material might furnish us with extremely significant information relative to such variations within a species from the same general region.

# BOTANICAL MUSEUM LEAFLETS
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# STUDIES ON PERUVIAN PLEUROTHALLIS


BY

CHARLES SCHWEINFURTH


THE following notes on Pleurothallis in Peru include two new species and six new varieties, as well as other nomenclatural discussions.

**Pleurothallis angustipetala** *C. Schweinfurth sp. nov.*

Herba mediocris, epiphytica, cum rhizomate repenti. Caules graciles, unifoliati, vaginis pluribus ornati. Folium breviter petiolatum; lamina oblongo-elliptica, obtusa vel acuta, basi cuneata. Inflorescentia unica, folio multo longior, supra subdense multiflora. Flores minores, secundi, cum segmentis patentibus. Sepala similia, lanceolata vel anguste lanceolata, supra longe angustata, lateralia leviter recurva. Petala circiter duplo breviora, linearia, acuta. Labellum petalis paulo longius, lateraliter visum sigmoideum, pandurato-oblongum, obtusum vel subacutum; pars basalis carinis binis humilibus ornata; pars anterior paulo major, oblongo-ovata. Columna parva, cum ala terminali tridentata.

Plant medium-sized, epiphytic, slender. Rhizome creeping, concealed by blackish sheaths. Roots fibrous, glabrous. Stems apparently in pairs, slender, about 4–11 cm. long, unifoliate, bearing three or four close, tubular sheaths, the uppermost being longest and commonly separated. Leaf petioled, up to 7.2 cm. long; lamina

oblong-elliptic, acute or obtuse, cuneate below, up to 6.5 cm. long and 1.8 cm. wide. Inflorescence solitary, nearly twice as long as the leaf, about 12.2 cm. or less long, suberect, densely or subdensely many-flowered above, looser below. Flowers commonly secund, rather small, yellow-green, with spreading segments. Sepals minutely cellular-papillose within. Dorsal sepal narrowly lanceolate, long-narrowed to an acute apex, concave below, up to 9.8 mm. long and 2.6 mm. wide near the base. Lateral sepals lanceolate, oblique and gently recurved above, up to 9.9 mm. long and 2.9 mm. wide. Petals much smaller than the sepals, linear, acute, prominently 1-nerved throughout, about 4.6 mm. long, up to 1 mm. wide. Lip somewhat longer than the petals, sigmoid when viewed from the side in natural position, pandurate-oblong, about 5.9 mm. long when expanded, up to 2.1 mm. wide above the middle, obtuse or subacute; basal portion very shortly clawed, subquadrate-oblong, with a pair of low keels that extend onto the basal part of the anterior portion; anterior portion slightly longer and broader, oblong-ovate. Column small, shorter than the petals, about 3 mm. long, narrowly winged on each side, with a short trilobulate wing at the apex, produced into a short foot.

This species superficially resembles *Pleurothallis rubens* Lindl., but commonly shows a creeping rhizome producing stems in pairs, has very narrow petals and a lip which differs in several details.

Cuzco: Prov. of Paucartambo, Pillahuata, at 2800 meters altitude, epiphyte, January 25, 1945, *C. Vargas 4956* (Type in Herb. Ames No. 65385); Same locality, at 3200 meters altitude, epiphytic in rain forest, "ceja de montaña," December 11, 1942, *C. Vargas 3006a.*

**Pleurothallis ciliata** *Knowl. & Weste.* var. **abbreviata** *C. Schweinfurth var. nov.*

Herba variabilis, inflorescentiis abbreviatis et floribus

extus dense pubescentibus et labelli basi cum lobulis parvis dentiformibus a specie differt.

Plant epiphytic, medium-sized to large, apparently with a creeping rhizome. Stems unifoliate, 6–27 cm. long, with two or three close, tubular, evanescent sheaths near the base. Leaf erect, oblong-elliptic, subacute, cuneate at the sessile base, 9–14 cm. long, up to 3.5 cm. wide. Inflorescences one or two (perhaps more), abbreviated, nodding, densely few-flowered. Flowers small, finely short-pubescent without, bilabiate, brownish yellow somewhat "striped with darker brown-yellow." Dorsal sepal narrowly oblong-lanceolate, acute and mucronate, up to 9.4 mm. long and 2.2 mm. wide, 3- to 5-nerved. Lateral sepals connate into an elliptic-lanceolate, sharply bidentate lamina which is about as long as the dorsal sepal but nearly twice as wide. Petals much smaller than the sepals, elliptic-lanceolate, short-acuminate, serrate above, about 4 mm. long and 1.2 mm. wide near the middle. Lip smaller than the petals, lightly arcuate below, ovate-oblong, rounded at the apex, trilobulate above the cuneate base with a pair of small, erect, dentiform, obtuse lateral lobes, bicarinate through the middle, about 2.2 mm. long. Column about as long as the lip, abruptly dilated above.

This variety of a widespread species is commonly distinctly larger than the type and has very short inflorescences. Moreover, the flowers are densely pubescent without, and the lip has short but distinct lateral lobules.

HUANUCO: Yanano, at about 1800 meters altitude, on mossy tree, May 13–16, 1923, *J. Francis Macbride 3837* (TYPE in Herb. Ames No. 37529).

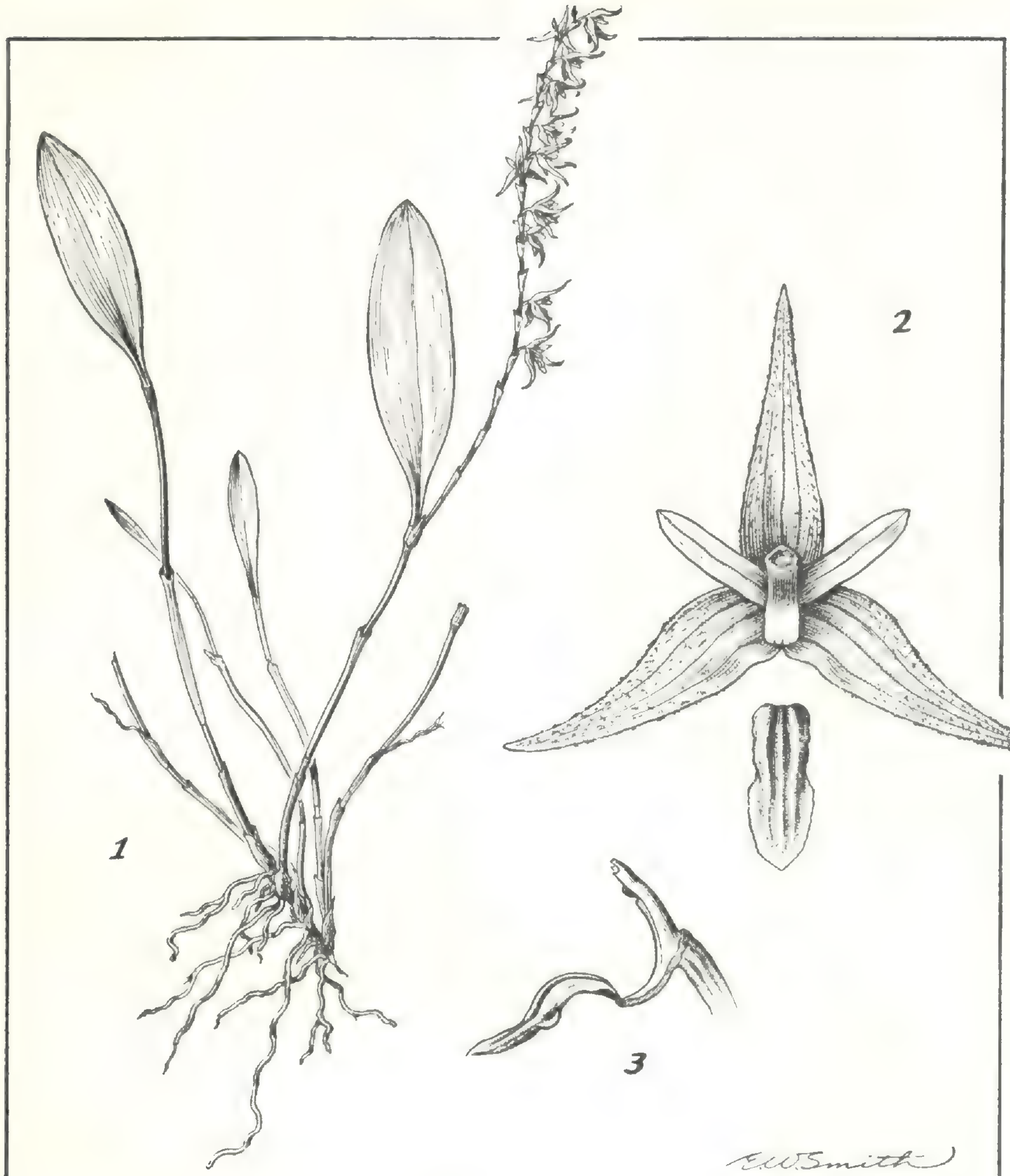
JUNÍN: Chanchamayo Valley, at 1200 meters altitude, September 1930, *Carlos Schunke 1127* (whole plant very small).

**Pleurothallis ciliata** *Knowl. & Westc.* var. **elongata** *C. Schweinfurth var. nov.*

## EXPLANATION OF THE ILLUSTRATION

PLATE V. PLEUROTHALLIS ANGUSTIPETALA *C. Schweinfurth.* 1, plant, one half natural size. 2, flower expanded, three and one half times natural size. 3, column and lip from side, natural position, three and one half times natural size.

*Drawn by* ELMER W. SMITH




PLEUROTHALLIS
*angustipetala*
*C. Schweinf.*

Herba mediocris, inflorescentiis folio multo longioribus et petalis caudatis a specie differt.

Plant epiphytic, with a creeping rhizome. Stems slender, unifoliate, 5–8 cm. long, with two close, tubular, evanescent sheaths below, about 1 cm. or more apart. Leaf erect, oblong-elliptic to oblong-oblanceolate, acute, cuneate at the sessile base, up to 7.7 cm. long and 2 cm. wide. Inflorescences one or two, much exceeding the leaf, arcuate to lax, loosely several-flowered above, up to about 18 cm. long. Flowers rather small, bilabiate, greenish yellow striped with red-brown, glabrous. Dorsal sepal narrowly lanceolate-oblong, acute and apiculate, about 14 mm. long and 2.8 mm. wide. Lateral sepals connate into a broadly oblong, apically bidentate lamina which is about as long as the dorsal sepal but twice as broad. Petals much smaller than the sepals, oblong-lanceolate, lacerate-dentate above the base (especially on the anterior margin), long-caudate above, about 7 mm. long. Lip shortly clawed, about 4 mm. long, lightly recurved below; lamina oblong-ovate, obtuse, subtruncate at base, erose-denticulate, with a pair of remote obscure carinate thickenings below, about 2 mm. wide; claw short, with a fleshy U-shaped callus. Column small, arcuate, wing-dilated above, about 3 mm. high at the back.

This concept differs from the variable *Pleurothallis ciliata* in having the inflorescences much surpassing the leaf and in having the petals long-caudate.

Loreto: Vicinity of Iquitos, at 100 meters altitude, on living tree in clearing, November to December 1936, *G. Klug 10013* (Type in Herb. Ames No. 60889).

**Pleurothallis excisa** *C. Schweinfurth sp. nov.*

Herba major, epiphytica, caespitosa. Caules approximati, unifoliati, vaginis pluribus tubulatis ornati. Folium breviter petiolatum, erectum; lamina oblongo-elliptica, apice obtusa, basi cuneata. Inflorescentiae saepissime

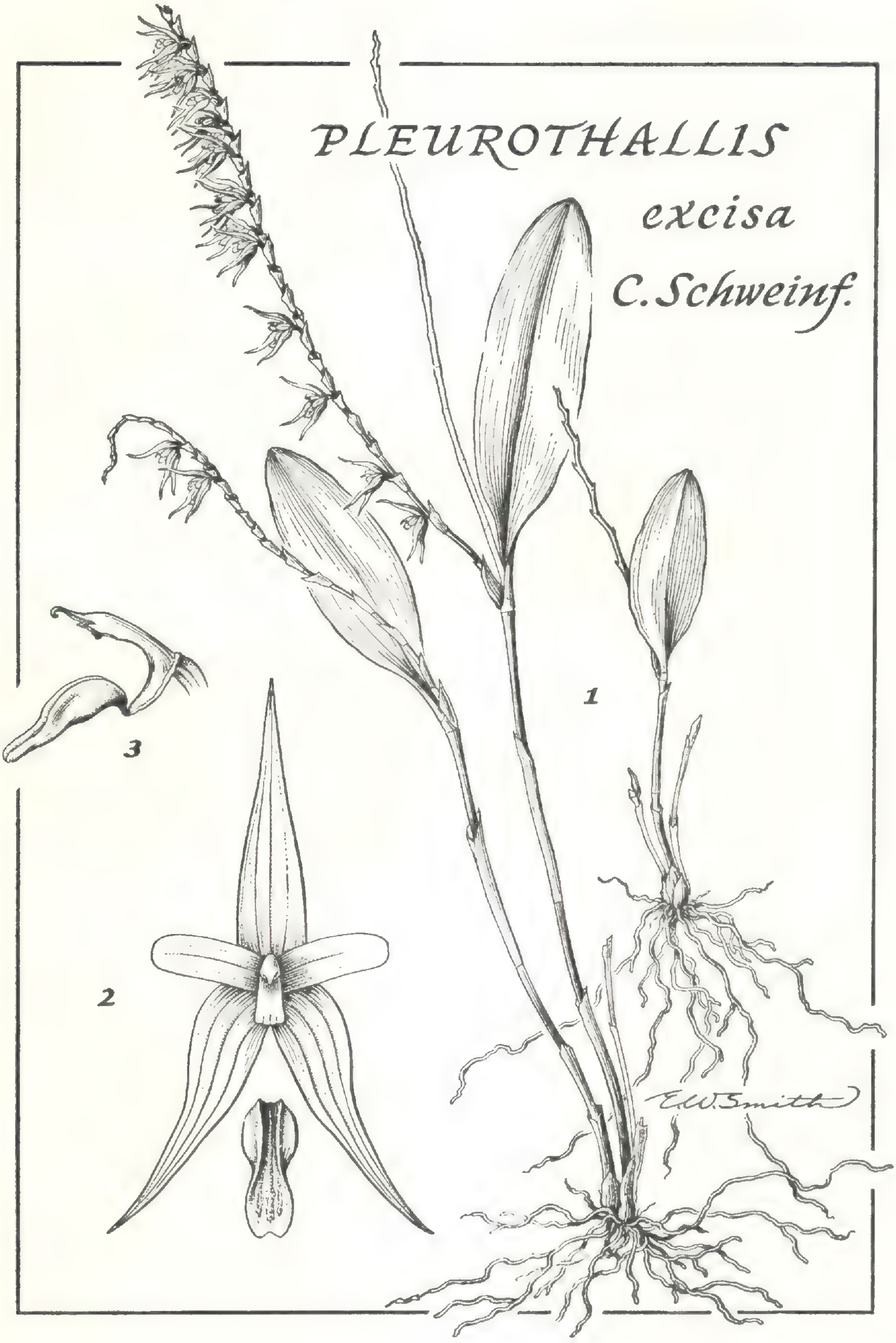
unicae, folium multo superantes, supra dense multiflorae. Flores secundi, aurei. Sepala similia, lineari-lanceolata, longe acuminata, tubulari-concava, lateralia valde obliqua, quam sepalum dorsale latiora. Petala multo minora, oblique oblonga, apice rotundata vel subtruncata. Labellum petalis paulo majus, pandurato-oblongum, dimidio basali subelliptico cum carinis binis conspicuis percurso, dimidio apicali ovato-elliptico, exciso. Columna parva, gracilis, arcuata.

Plant rather large, epiphytic, up to about 30 cm. or more tall. Roots fibrous, numerous, elongate, glabrous. Stems approximate, unifoliate, up to 15.3 cm. long, provided with three or four close, tubular sheaths of which the uppermost is separated and elongate. Leaf short-petioled, up to 10.2 cm. long; lamina oblong-elliptic, minutely apiculate at the obtuse apex, cuneate at the base, up to 9 cm. long and 2.5 cm. wide, coriaceous. Inflorescences one or two, much surpassing the leaf, many-flowered, dense above, loose below, 17–18.7 cm. long, erect or spreading, in the axil of a small conduplicate spathe up to 11 mm. long. Flowers secund, yellow, medium-sized, with spreading segments. Sepals similar, narrow, long-acuminate, tubular-concave. Dorsal sepal linear-lanceolate, about 12 mm. long and 2.8 mm. wide near the base when expanded. Lateral sepals lanceolate, very oblique below, about as long as the dorsal sepal, 2.9 mm. wide, long-decurrent on the column-foot. Petals much smaller than the sepals, obliquely oblong, rounded or subtruncate at the apex, about 4.6 mm. long and 1.8 mm. wide. Lip slightly larger than the petals, pandurate-oblong, abruptly recurved at the base, about 5.6 mm. long; basal half subelliptic, traversed by a pair of high fleshy keels; anterior half elliptic-ovate, bidentate at the apex, concave. Column small, slender, arcuate, extended into a long ligulate apical wing which is incurved at the

## EXPLANATION OF THE ILLUSTRATION

PLATE VI. PLEUROTHALLIS EXCISA *C. Schweinfurth.* 1, plants, one half natural size. 2, flower expanded, three times natural size. 3, column and lip from side, natural position, three times natural size.

*Drawn by* ELMER W. SMITH


PLEUROTHALLIS
excisa
C. Schweinf.
1
2
3
E.W. Smith

tip, about 5.5 mm. high including the wing, prolonged into a prominent curved foot.

Among the South American species, this plant recalls *Pleurothallis rubens* Lindl., but has a dissimilar lip. It appears to be more closely allied to the Central American *P. dolichopus* Schltr., but is unique in having an excised lip.

Cuzco: Prov. of Paucartambo, Pillahuata, at 3200 meters altitude, epiphytic in rain forest, "ceja de montaña," December 11, 1942, *C. Vargas 3006* (Type in Herb. Ames No. 65388).

**Pleurothallis fimbrilabia** *C. Schweinfurth nom. nov.*

*Restrepia ecuadorensis* Rolfe in Kew Bull. (1892) 138, non *Pleurothallis ecuadorensis* Schltr.

Plant rather small, epiphytic, with a creeping rhizome. Stems approximate, slender, several-jointed, about 4–10 cm. high, entirely or mostly concealed by several (up to 7) sheaths which are loose, tubular, scarious and finely red-purple maculate (the upper ones maculate only at their base). Leaf solitary, erect, oblong-elliptic to oval, obtuse or acute, cuneate at the sessile base, up to 6 cm. long and 2.9 cm. wide. Inflorescences fascicled, one to several, 1-flowered, issuing from the uppermost sheath just below the leaf, with the pedicel about 5 cm. long. Flower rather large for the genus, bilabiate, membranaceous. Dorsal sepal linear-lanceolate, about 2.2 cm. long, from a concave oblong-lanceolate lower portion gradually narrowed to a filiform apex which is clavate-thickened near the tip. Lateral sepals connate into an elliptic-oblong bidentate lamina which is subequally long with the dorsal sepal but more than twice as wide. Petals similar to the dorsal sepal but much smaller, the oblong-lanceolate lower portion sometimes with a more or less distinct appressed tooth. Lip about 9 mm. long, abruptly dilated from a small claw into a relatively broad suborbicular

basal portion provided on each side with a slender setiform lobule, then contracted into a linear-oblong, sharply bidentate lamina which is erose-fimbriate and muriculate through the center. Column slender, clavate above, about half as long as the lip.

This description is mostly based on the Peruvian collection cited below which differs in some respects from Rolfe's Ecuadorian material. The dorsal sepal and petals are slightly shorter. The sepals and petals are noted as translucent white lined with red or maroon, the lateral sepals being yellow thickly spotted with maroon or dark red. Since we consider that the concept *Restrepia* HBK. is referable to the variable genus *Pleurothallis* R.Br., I have made the above transfer. A new specific epithet is necessary, since the name *Pleurothallis ecuadorensis* was given to another species by Schlechter in 1915.

HUANUCO: Muña, at about 2100 meters altitude, in dense forest, *J. Francis Macbride 4018.*

**Pleurothallis floribunda** *Poeppig & Endlicher* Nov. Gen. ac Sp. 1 (1836) 48, t. 84.

*Pleurothallis macrophylla* HBK. sensu Lindley in Bot. Reg. 28 (1842) Misc. p. 74, no. 44; Fol. Orch. Pleurothallis (1859) p. 3, no. 2.

*Pleurothallis macrophylla* HBK. sensu Cogniaux in Martius Fl. Bras. 3, pt. 4 (1896) 396.

Several authors of note, especially John Lindley and Alfred Cogniaux, have treated *Pleurothallis floribunda* Poepp. & Endl. as referable to the older **P. macrophylla** *HBK.* However, a careful consideration of the available evidence, including a photograph of *P. macrophylla* from the Muséum d'Histoire Naturelle at Paris, has convinced me that the two concepts are amply distinct. The differences are shown in the following table.

| *P. floribunda* | *P. macrophylla* |
|---|---|
| Leaf distinctly petioled | Leaf sessile |
| Flowers subsessile | Flowers with a rather elongate slender pedicel |
| Lateral sepals free to the base | Lateral sepals connate up to the apex |
| Petals half as long as the sepals, 1-nerved | Petals a little shorter than the sepals, 3-nerved |
| Lip subrotund in the middle and narrowed toward the base and apex, concave, scarcely shorter than the petals | Lip ligulate with revolute margins, a little shorter than the sepals |
| Habitat: Peru | Habitat: Colombia |

**Pleurothallis juninensis** *Schltr.* var. **subaequisepala** *C. Schweinfurth var. nov.*

Herba foliis magis oblongis acutis et sepalis subaequilatis et sepalo dorsali ovato vel ovato-lanceolato a specie differt.

Plant large, caespitose, up to 37 cm. tall from the base of the stem to the tip of an erect leaf. Stems 14–27.5 cm. long, often stouter than in the type. Leaf ovate-oblong or elliptic-oblong, erect or widely spreading, shortly cordate at base, acute or short-acuminate at the apex, 10–11 cm. long, up to 3.5 cm. wide. Flowers bilabiate, brown or reddish. Dorsal sepal oblong-ovate or ovate-lanceolate, acute or acuminate, about 9.5–16 mm. long, up to 5.4 mm. wide. Lateral sepals connate into an oblong-ovate or oblong-lanceolate lamina which is subequally long with the dorsal sepal and slightly narrower, acute or acuminate. Petals similar to those of the type. Lip similar to the typical form, oblong, rounded and minutely apiculate at the apex, scabrous, 5.1–6.1 mm. long.

This variety differs from the type in having the leaves broadest near or at the middle and especially in having the sepals more ovate or ovate-lanceolate with the dorsal

sepal slightly broader than the lamina of the lateral sepals. It occurs at a rather greater altitude than the type.

Cuzco: Prov. of Convención, Hda. Potrero, Sapan Sachayocc, at 2200 meters altitude, epiphytic in dense forest, March 5, 1942, *C. Vargas 2561* (Type in Herb. Ames No. 65371); "Pillahuata," Cerro de Cusilluyoc, above Río Pillahuata, at 2300–2400 meters altitude, epiphyte in forest, May 3–6, 1925, *F. W. Pennell 14005*.

## Pleurothallis Lindenii *Lindley* var. longiracema *C. Schweinfurth var. nov.*

Herba mediocris, inflorescentia stricta quam folium longiore et petalis oblongo-linearibus et labello trilobulato a specie differt.

Plant medium-sized, up to 39 cm. tall. Stems often proliferating, the lower stems about 9–21 cm. long from a decumbent base, unifoliate, with 3 or 4 close, tubular, evanescent sheaths. Leaves sessile or very short-petioled, ovate-oblong to elliptic-oblong, acute or acuminate, cuneate at the base, up to 11.5 cm. long and 2.8 cm. wide. Inflorescences solitary, strict or nearly so, loosely few- to several-flowered, up to 18 cm. long, rising from a more or less conspicuous, conduplicate spathe up to 1.9 cm. long. Flowers bilabiate, rather similar to those of the type, apparently densely spotted. Dorsal sepal oblong-ovate, acuminate, concave, about 10 mm. long and 5.2 mm. wide when expanded. Lateral sepals entirely connate into a deeply concave suborbicular-ovate lamina which is slightly longer but much broader than the dorsal sepal. Petals oblong-linear, acute, suboblique, about 7.5 mm. long. Lip much shorter than the other segments, suborbicular-ovate in outline, lightly but distinctly 3-lobed, cordate at the base, acute at the apex, about 4 mm. long and 5.2 mm. wide; lateral lobes obliquely ovate-rounded, apparently contracted by a median transverse keel; mid-lobe larger, triangular-ovate. Column minute, stout.

This variety differs from the type in having strict racemes which are more or less longer than the leaf, much narrower petals and a trilobulate lip.

Cuzco: Prov. of Urubamba, Tuncapata, Sta. Rita, at 2800 meters altitude, epiphytic, flower yellow-brown, March 28, 1942, *C. Vargas 2663* (Type in Herb. Ames No. 65369); Near Tuncapata, at 2600 meters altitude, "laderas junto al camino entre herbaceas," March 10, 1944, *C. Vargas 4098*.

**Pleurothallis pedunculata** (*Kl.*) *Reichb.f.* var. **peruviana** *C. Schweinfurth var. nov.*

Herba inflorescentiis quam folium multo longioribus et floribus minoribus et segmentis angustioribus et labello magis ovato a specie differt.

Plant large, 30 to over 40 cm. high. Stems approximate, rather slender, unifoliate, 8–18 cm. long, with two or three close, tubular, evanescent sheaths. Leaf shortly but distinctly petioled; lamina ovate-oblong to oblong-elliptic, acute with a minutely tridenticulate apex, broadly cuneate at the base, up to 13.5 cm. long and 4.3 cm. wide. Inflorescences one to three, suberect to flexuous, about 23 cm. or less long, loosely few- to several-flowered, subtended by a conspicuous conduplicate spathe up to 5.7 cm. long. Flowers smaller than in the species, "reddish-greenish-yellow." Dorsal sepal linear-lanceolate, gradually narrowed to an obtuse tip, about 1.6 cm. long and 2.3 mm. wide at the concave base. Lateral sepals connate into an oblong-lanceolate, long-acuminate lamina which is slightly shorter but much broader than the dorsal sepal. Petals lanceolate-linear, caudate-acuminate and fleshy above, almost as long as the dorsal sepal. Lip much shorter than the other segments, tubular-involute in natural position, oblong-ovate when expanded, rounded at the apex, about 5.9 mm. long and 4 mm. wide near the base, with the anterior half rather abruptly contracted. Column minute.

This variety diverges from the type in having the inflorescences much longer than the leaf, smaller flowers with narrower segments and a more ovate lip.

HUANUCO: Yanano, at about 1800 meters altitude, in patches on humus, May 13–16, 1923, *J. Francis Macbride 3849* (TYPE in Herb. Ames No. 60876).

**Pleurothallis tenuifolia** *C. Schweinf.* var. **longisepala** *C. Schweinfurth var. nov.*

Herba mediocris, caespitosa, caulibus gracilioribus et foliis angustioribus et sepalis longioribus a specie differt.

Plant medium-sized, caespitose, epiphytic, with an abbreviated rhizome. Stems approximate, numerous, unifoliate, very slender, up to 11 cm. long, provided with two or three close, tubular, evanescent sheaths. Leaf erect or spreading, narrowly linear, abruptly obtuse to subacute with a minute apicule, gradually narrowed below to a subpetioled base, the margins being conspicuously revolute, up to 13.5 cm. long and 5 mm. wide in the dried specimen. Inflorescences commonly solitary (sometimes the remnants of four peduncles are present), lax or nodding, loosely several- to many-flowered almost to the base, markedly shorter than the leaf, up to about 9 cm. long. Flowers yellowish white. Sepals free, spreading above, finely papillose-pubescent within, 3-nerved. Dorsal sepal lanceolate-linear, concave below, about 20 mm. long and 2 mm. wide near the base. Lateral sepals very similar, lightly oblique. Petals much smaller than the sepals, cuneate-oblong, subacute, lightly oblique, about 4 mm. long and 1.8 mm. wide above. Lip lightly recurved in natural position, oblong-oblanceolate, obtuse at the apex, gradually narrowed toward the base, about 5 mm. long and 1.8 mm. wide above, lightly bicarinate near the middle. Column very small, shorter than the petals, wing-dilated above, denticulate at the apex, about 3 mm. high at the back.

This plant differs from *P. tenuifolia* in being more slender throughout, with narrower leaves, shorter inflorescences and much longer sepals.

HUANUCO: Prov. of Pachitea, above La Molina near Panao, September 12, 1940, *Erik Asplund 13697*.

**Pleurothallis tunguraguae** *Lehmann & Kränzlin* in Engler Bot. Jahrb. 26 (1899) 439.

A collection of this Ecuadorian species has recently been made in Peru. It differs from an isotype specimen in the Ames Herbarium in having markedly broader leaves (3.1–3.6 cm., as contrasted with 2.5 cm.), only two inflorescences (as compared with five in the isotype) and the flowers somewhat larger than those described, although but little larger than those in the isotype. Also the mid-lobe of the lip in the type is relatively larger than the lateral lobes.

AMAZONAS: Prov. of Bongara, on ridges above Quebrada Santa Rosa, across northeast end of Lake Pomacochas, at 2430 meters altitude, epiphytic in mountain rain forest, flowers white, April 4, 1944, *W. H. Hodge 6154*.

# BOTANICAL MUSEUM LEAFLETS
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# PLANTAE AUSTRO-AMERICANAE VIII
## DE PLANTIS PRINCIPALITER VALLIS AMAZONICIS NOVIS VEL CRITICIS NOTAE DIVERSAE


BY

RICHARD EVANS SCHULTES[1]


STUDIES which have been carried on during the past two or three years have disclosed in recent plant collections from South America a number of species which are new to science or otherwise noteworthy. This article is a continuation of a series dedicated to the widening of our understanding of the flora of northern South America, with special reference to the Amazon basin.


It is with pleasure that I acknowledge the collaboration of Mr. Jason R. Swallen (*Gramineae*); Dr. Harold N. Moldenke (*Eriocaulaceae*); and Mr. Emery C. Leonard (*Acanthaceae*).


### GRAMINEAE

**Panicum molliculmum** *Swallen sp. nov.*

Annuum (?); culmi tenuissimi, decumbentes, 5–15 cm. longi, glabri; vaginae internodiis $\frac{1}{2}$ breviores, pilosae; ligula brevissima, ciliata; laminae 5–10 mm. longae, 2–4 mm. latae, obtusae, basi subtruncatae, hirtellae; paniculae terminales et axillares, simplicissimae, pedunculis


[1] Botanist, Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Research Fellow, Botanical Museum of Harvard University.

filiformibus, spiculis 1–5 breviter pedicellatis; spiculae 1.2–1.5 mm. longae; gluma prima minuta; gluma secunda et lemma sterile aequales, fructu paulo longiora, acuta, pilosa; fructus minute rugosus.

Swallen states: "This species is not closely related to any known species of the genus *Panicum*. It is unusual in having few to several axillary inflorescences from the upper nodes, these long exserted on long filiform peduncles."

COLOMBIA: Comisaría del Caquetá, Cerro de El Castillo, Río Apaporis. Damp sandstone ledge with mosses and *Selaginellas*. January 16, 1942, *Gabriel Gutiérrez & Richard Evans Schultes 616* (TYPE in U.S. Nat. Herb.).

## CYPERACEAE

**Cephalocarpus Dracaenula** *Nees* in Martius Fl. Bras. 2, pt. 1 (1842) 162, t. 18.

The collection which is cited below establishes the occurrence of this curious epiphytic cyperaceous plant far to the north of its only other known locality, the Cerro de La Pedrera on the Río Caquetá at the Colombian-Brazilian boundary (Schultes in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 293).

Additional material and more exact knowledge of this genus may indicate that *Schultes & López 10066* represents a variety of *Cephalocarpus Dracaenula*, but it seems to match this species as delineated by Gilly (in Bull. Torr. Bot. Club 69 (1942) 290).

COLOMBIA: Comisaría del Vaupés, Río Guainía basin, Río Naquieni, vicinity of Cerro Monachí. "Common epiphyte on rocks amidst mosses and lichens and on trunks. Flowers very small, white. On summit of mountain." June 1948, *Richard Evans Schultes & Francisco López 10066*.

## CYCLANTHACEAE

**Carludovica aurantiaca** *R. E. Schultes sp. nov.*

Planta caulescens, terrestris, in rivulorum saxis colonice

crescens. Caulis comparate robustus, sublignosus, usque ad 10 cm. longus vel longior, 1.7 cm. in diametro, asperiter fibroso-squamosus. Petioli tenuissimi, usque ad 50 cm. longi, basi dilatati, vaginis linearibus inclusi. Foliorum laminae usque ad 35 cm. longae, 5/6 longitudinaliter bipartitae; segmenta anguste linearia (saepissime longitudinaliter lacerata), apice filiformia, basi plusminusve 6 mm. lata. Pedunculi magnopere tenuissimi, usque ad 40 cm. longi, plerumque 2 mm. in diametro, fortiter fibrosi. Spathae hyalinae, vivo triangulares, apice acutae, usque ad 4 cm. longae, 2.5 cm. latae, superior lineari-triangularis, apice longissime attenuata, basi 2–3 cm. lata, 6.5–10 cm. longa. Spadix cylindricus, apice rotundatus, 16 mm. longus, usque ad (sed saepissime multo brevior) 7–11 mm. in diametro. Flores pistillati parvi, 2 mm. in diametro, subconcrescentes, perianthio quadrilobato; stigmatibus carnosis, in apicem ovarii confluentibus, cruciformibus, in circuitu oblongis, 1.3 mm. longis, 0.3 mm. latis. Flores staminiferi conspicui, 1–1.5 mm. in diametro; pedicellis valde complanatis, 1.5 mm. longis, perianthii lobis liberis suborbicularibus, apice rotundatis, 1.5 mm. longis, circiter 1 mm. latis; staminibus numerosissimis (usque ad sexaginta), filamentis brevibus, antheris in circuitu suborbicularibus, 0.4 mm. in diametro, bilocularibus; staminodia conspicuissima, caduca, filiformia, usque ad 7 vel 10 cm. longa, splendide aurantiaca.

This new species of *Carludovica* is a beautiful and graceful plant which grows in dense and extensive colonies. It can be distinguished from all other described members of the genus by its rich orange-colored staminodes. It approaches in some respects *Carludovica pygmaea* Gleason, but can be separated from this species by its much longer and more narrowly linear leaves and its larger floral bracts.

Colombia: Comisaría del Vaupés, Río Guainía basin, Río Naquieni, vicinity of Cerro Monachí. "Epiphyte on rocks in rapids. Flowers

white, excessively fragrant of narcissus. Staminodes bright orange. In caatinga forest at base of mountain." June 1948, *Richard Evans Schultes & Francisco López 10085* (TYPE in Herb. Gray).

## ARACEAE

### Anthurium atropurpureum *Schultes & Maguire sp. nov.*

Herba terrestris, parva, in silva non densa arenosa humida crescens. Caudiculus magnopere abbreviatus, robustus, internodiis brevissimis. Folia rigide erecta, cum petiolis strictis, vivo aliquid complanatis, striatis, basi usque ad 5 mm. in diametro; lamina valde chartacea, clare viridis, glabra, lanceolato-elliptica, apice longe acuminata (acumine quam 2 cm. longiore), basi attenuata, leviter marginata, nervis secundariis plusminusve novem, arcuatis, confluentibus, subtus prominenter elevatis, supra paulo elevatis. Inflorescentia erecta, pedunculo aliquid carnosulo ut videtur, vivo probabiliter subcomplanato, plusminusve 1 mm. in diametro, purpureo. Spatha membranacea, atropurpurea, lanceolata, apice acutissima, 2.5 cm. longa, 5 mm. lata, petiolum cingens. Spadix erectus, cylindricus, 2.5 cm. longus, 3 mm. in diametro, atropurpureus. Flores valde regulares, quadrangulares.

*Anthurium atropurpureum* would seem to be set apart from other small Amazonian species of the genus by the combination of its unusual leaf shape and the deep, rich purple color of the fertile parts. Although it was collected in the same locality as the following species, the two concepts are not closely related.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, "Varial perto da Quebrada Agua Prêta. Epiphyta no chão." November 8, 1946, *George A. Black & Richard Evans Schultes 46-375* (TYPE in Herb. Gray).

### Anthurium fontoides *R. E. Schultes sp. nov.*

Herba epiphytica, parva, gracillima. Caudiculus cras-

sus internodiis abbreviatis. Folia coriacea, petiolis strictis, crassis teretibusque, sulcatis, basi latiuscule dilatatis, usque ad 2 cm. longis, 1.5–2 mm. in diametro; lamina pallide viridis, glabra, lineari-lanceolata, apice longissime acuminata, basi longe cuneata et decurrens, margine leviter revoluta, subtus minute tessellato-squamulosa, 18–26 cm. longa, 1.2–1.4 cm. lata, nervis crassis, utrinque proinentibus, secundariis duobus nervo centrali parallelis. Inflorescentia brevis, gracilis, pedunculo usque ad 6 cm. longo, leviter complanato. Spatha firme membranacea, lineari-lanceolata, apice acuta, usque ad 3 cm. longa, 2 mm. lata, vivo reflexa, ut videtur rubens vel purpurea. Spadix sessilis, cylindricus, apicem versus non attenuatus, 6–7 cm. longus, plusminusve 3 mm. in diametro, probabiliter flavus.

*Anthurium fontoides* is very closely related to *A. gracile* (Rudge) Engl., a widespread tropical American species of which several varieties have been recognized. Later studies and collections may indicate that the concept here described as a species is deserving only of varietal rank. *Anthurium fontoides* can be separated from *A. gracile* on first sight by its narrower leaves which are basally decurrent, by the more closely packed basal bracts, by its much shorter petioles, and by its smaller spathe. Perhaps the greatest difference is to be found in its having an inflorescence which, instead of being subequal to the leaves, is less than half as long.

The specific epithet was suggested by the graceful habit of the leaves.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, Loretoyacu River. Alt. about 100 m. "Epiphytic." September 1946, *Richard Evans Schultes & George A. Black 8399* (TYPE in Herb. Gray).

**Anthurium nemoricola** *Schultes & Maguire sp. nov.*

Herba terrestris, humillima, in silva non densa arenosa

humida crescens. Caudiculus abbreviatus, erectus, internodiis magnopere brevissimis. Folia rigide erecta, cum petiolis strictis usque ad 8 cm. longis, basi teretibus, apice aliquid canaliculatis; lamina valde coriacea, glabra, subtus tessellata, subsagittata (ad basim leviter lobata), 7–9 cm. longa, basi 2.8–3.2 cm. lata, apice acuminata, basi rotundata, margine integra, valde revoluta, nervis secundariis duobus nervo centrali subparallelibus, adscendentibus, tertianis decem vel duodecim, subtus nervis prominenter elevatis supra conspicue canaliculato-depressis. Inflorescentia erecta, pedunculo 11 cm. longo, cylindrico. Spatha vivo reflexa, anguste lanceolata, acuta, extus pulverulenta, 2.5 cm. longa, 6 mm. lata, sanguinea. Spadix erectus, albus, 2 cm. longus, cylindricus, tenuis (2 mm. in diametro), ad apicem attenuatus. Flores quadrangulares, regulares.

The minute stature of *Anthurium nemoricola*, combined with the unusual shape, venation and texture of the leaves, serve to set this concept apart from other Amazonian species of the genus. It is highly adapted to the xerophytic conditions which obtain, in spite of ample rainfall, because of high acidity. The habitat, as indicated by the specific epithet, is a light savanna-forest of small treelets and abundant light.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, interior regions of trapecio between Amazon and Putumayo watersheds. Altitude above 100 m. "In sandy savanna-forests or *varial*." November 1945, *Richard Evans Schultes 6900A* (TYPE in Herb. Gray).

### Anthurium pluviaticum *R. E. Schultes sp. nov.*

Herba epiphytica, parva. Caudiculus abbreviatus, satis robustus, internodiis brevibus. Folia tenuiter papyracea, erecta, cum petiolis gracillimis vivo ut videtur teretibus, obscurissime striatis, basi usque ad 2.2 mm. in diametro, 4.5–6 cm. longis; lamina pallide viridis, glabra, regulariter hastata, apice breviter acuminata, basi valde cordata,

omnino magnopere minutissime tessellato-squamulosa, 7.5–10 cm. longa, 6–7.5 cm. lata (parte centrali); nervo centrali robusto, nervis secundariis valde arcuatis, tertianis angulatim 45° patentibus, nervis omnibus supra inconspicuis sed subtus prominentioribus. Inflorescentia erecta, gracillima, pedunculo usque ad 16 cm. longo, cylindrico. Spatha viridis, vivo valde reflexa, membranacea et hyalina, oculo armato minutissime squamulosa, nervulis prominentibus, lanceolato-elliptica, apice acutissima, 4.5 cm. longa, 7.5–8 mm. lata. Spadix erectus, albidus, usque ad 5 cm. longus, cylindricus, comparate tenuis (3 mm. in diametro, ad apicem non attenuatus), stipite 1.5 cm. longo suffultus. Flores valde regulares, subquadrangulares.

From other species with similar hastate leaves, *Anthurium pluviaticum* can be distinguished by its long-stipitate and unusually slender spadix, by its very abbreviated caudicle and by the small size of all its parts. It would seem to resemble the type of *Anthurium chlorocarpum* Sodiro in some respects, but its leaves are smaller, more acuminate and more nearly membranaceous, and it has an inflorescence which, in addition to the stipitate spadix, shows important morphological differences.

The specific epithet of *Anthurium pluviaticum* recognizes that the plant grows in an area which has one of the world's heaviest rainfalls.

Colombia: Departamento del Valle, Río Calima, Quebrada de La Brea. Alt. 30–40 m. "Epiphyte. Spike white." May 19, 1946, *Richard Evans Schultes & Mardoqueo Villarreal 7348* (Type in U.S. Nat. Herb.).

## Anthurium tikunorum *R. E. Schultes sp. nov.*

Herba terrestris, usque ad $1\frac{1}{2}$ pedes alta, in silva non dense arenosa, humida crescens. Caudiculus multo abbreviatus, erectus, internodiis brevissimis. Folia rigidissime erecta, cum petiolis strictis, 12–24 (plerumque plus-

minusve 20) cm. longis, basi teretibus, apice canaliculatis, vivo valde complanatis; lamina valde coriacea, glabra, utrinque minutissime tessellata, hastata, 14–16 cm. longa, parte centrali 3–5.5 cm. (vel basi 6.5–10 cm.) lata, apice acuta, basi truncata et abrupte triangulari-cuneata, lobis lateralibus rotundatis, margine integra, valde revoluta, nervis secundariis duobus nervo centrali subparallelis, adscendentibus, tertianis decem vel duodecim, subtus nervis prominenter elevatis supra conspicue canaliculatodepressis. Inflorescentia erecta, pedunculo robusto, cylindrico, conspicue striato-canaliculato, 30–35 cm. longo, 2 mm. in diametro sed basim versus aliquid dilatato. Spatha vivo reflexa, anguste lanceolata, acutissima, extus densius scrobiculata, 5.5 cm. longa, 6 mm. lata, probabiliter atrosanguinea vel fusco-rubens. Spadix erectus, non stipitatus, flavus, 5.5 cm. longus, maturitate 8 mm. in diametro. Flores quadrangulares, regulares, tepalis extus dense squamulosis. Baccae carnosae, virides, globosae, densae.

It is at once evident that *Anthurium tikunorum* is very intimately allied to *A. nemoricola* Schultes & Maguire from the same region, but there are differences which would seem to be of sufficient magnitude to warrant a specific, and not a varietal rank, for the concept described above. *Anthurium tikunorum* is very much larger in all its parts than *A. nemoricola;* the leaves of the former species are very definitely hastate with prominent lateral lobes basally whereas those of the latter are subsagittate, albeit with a slight suggestion of lobes which, however, do not develop.

The specific epithet of *Anthurium tikunorum* refers to the Tikuna Indians who inhabit Colombia's trapecio amazónico and adjacent areas of Brazil and Perú and who employ this plant to relieve a condition of pyorrhea which is not uncommon amongst them; the astringent

juice of the fleshy fruits is applied to staunch the flow of pus from the gums.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, interior regions of trapecio between Amazon and Putumayo watersheds. Alt. above 100 m. "Varial [caatinga] near headwaters of Pamaté. September 1946, *Richard Evans Schultes 8108* (TYPE in U.S. Nat. Herb.).

## ERIOCAULACEAE

**Paepalanthus fasciculatus** (*Rottb.*) *Körnicke* in Martius Fl. Bras. 3, pt. 1 (1863) 357.

A rather abundant though highly localized little plant, *Paepalanthus fasciculatus* seems to occur on the sandy savannas or caatingas of both cretaceous quartzite and cambrian granite origin—one of the relatively few species common to the floras of both of these geological areas in the northwestern Amazon. It is a species of the northwestern Amazon Valley and the upper reaches of the Orinoco.

BRAZIL: Estado do Amazonas, Rio Negro, Jucabí (at mouth of Rio Curicuriarí. September 23–24, 1947, *Richard Evans Schultes & Francisco López 8837.*—Estado do Amazonas, Rio Negro basin, Rio Curicuriarí, February 1948, *Richard Evans Schultes & Francisco López 9715.*

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, La Chorrera. "Witoto Indian name: *hõ-gö-nĕ.*" June 6, 1942, *Richard Evans Schultes 3943.*

**Paepalanthus Schultesii** *Moldenke sp. nov.*

Herba gracilis, caulescens; caulibus tenuibus, usque ad 12 cm. longis, foliosis; foliis membranaceis, graminoideis, patentibus, 2–3.5 cm. longis, medio 1–2.5 mm. latis, marginibus remote villoso-ciliatis, caeterum minutissime puberulis vel glabrescentibus; pedunculis paucis, 2–9 cm. longis, 4- vel 5-costatis, in juventute pilosis, denique glabris, tortis; vaginis 1.5–2 cm. longis, parce adpresso-pilosis, glabrescentibus, ad apicem 3-lobatis; capitulis griseis, hemisphaericis, 5–8 mm. in diametro.

Slender caulescent herb. Stems very slender, up to

about 12 cm. long, long-pilose when young, glabrescent in age, rather densely leafy. Leaves membranuos, uniformly dull green on both surfaces, grass-like, 2–3.5 cm. long, 1–2.5 mm. wide at the mid-point, attenuate-acute at the apex, 4- to 7-veined, but the veins not conspicuous, not fenestrate, rather remotely but very conspicuously villous-ciliate along the margins with stiff, divergent, white hairs about 3 mm. long, otherwise very minutely puberulous-pulverulent or glabrescent on both surfaces. Peduncles few, mostly 1 or 2 per season at the apex of the stem but several of previous seasons persistent farther down, erect, slender, 2–9 cm. long, 4- or 5-costate, twisted, antrorsely white-pilose when young, eventually glabrescent; sheaths slender, 1.5–2 cm. long, sparsely appressed-pilose or eventually glabrescent, conspicuously 3-lobed at the apex, the lobes subhyaline-scarious, lanceolate, about 4 mm. long, attenuate-acute at the apex, glabrous, erect. Heads grey, hemispheric, 5–8 mm. in diameter; involucral bractlets light brownish, ovate, about 3.5 mm. long and 1.9 mm. wide, slightly concave, rounded at the apex, densely short-ciliolate along the margins, otherwise subglabrous or sparsely pilose toward the apex on the back; receptacle long-villous; receptacular bractlets stramineous or light brownish, oblong-elliptic, about 2.8 mm. long and 0.9–1 mm. wide, blunt at the apex, ciliate-pilose toward the apex on the back and barbellate at the apex. Staminate florets: sepals 3, connate only at the base for about 1 mm., brownish, about 2.5 mm. long and 0.7 mm. wide, obtuse and barbate at the apex, otherwise glabrate; petals 3, whitish, connate into an infundibular tube about 2.5 mm. long, the upper free portions subhyaline and about 1 mm. long, glabrous, not glanduliferous; stamens 3, exserted, erect-spreading; filaments about 1.5 mm. long, glabrous; anthers white. Pistillate florets: sepals 3, brown, separate to the base,

hyaline, narrow-elliptic, about 2 mm. long and 1 mm. wide, acute at the apex, rather densely long-pilose with erect white hairs on both surfaces; pistil about 3 mm. long; ovary brown, 3-sulcate, 3-celled, 3-ovulate; style about 0.3 mm. long, glabrous; the 3-stigmas and 3 style-appendages issuing from the apex of the style, erect, about 1.5 mm. long.

COLOMBIA: Departamento de Cundinamarca, Macizo de Bogotá, Quebrada de Chapinero. Alt. about 9000 feet. September 24, 1941, *Richard Evans Schultes 1024* (TYPE in Herb. Britton, N.Y. Bot. Gard.).

## MENISPERMACEAE

**Abuta rufescens** *Aublet* Hist. Pl. Guian. 1 (1775) 618, t. 250.

This species is widespread from French Guiana south through the Amazon Valley to Minas Geraes. It has been identified as the species which Martius reported to be employed in the preparation of arrow-poison along the Río Caquetá (Japurá) (Krukoff & Moldenke in Brittonia 3 (1938) 67).

BRAZIL: Estado do Amazonas, Rio Negro basin, Rio Curicuriarí, near summit of Serra Curicuriarí. April 26, 1948, *Richard Evans Schultes & Francisco López 9827A.*

**Chondodendron toxicoferum** (*Wedd.*) *Krukoff & Moldenke* in Brittonia 3 (1939) 338.

*Chondodendron toxicoferum*, known from the western Amazonia of Perú and Brazil, has apparently not been hitherto reported from such a northwestern locality as the upper reaches of the Apaporis River where *Schultes 5526* was collected.

COLOMBIA: Comisaría del Vaupés, Macaya River, vicinity of Cachivera del Diablo. "Vine. Fruits yellow, bitter." May 1943, *Richard Evans Schultes 5526.*

**Hymenaea oblongifolia** *Huber* in Bol. Mus. Para. 5 (1909) 386.

*Cynometra Zamorana* R. E. Schultes in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 301, t. 34.

The collection *Philipson 1647* has very appreciably extended the known range of this beautiful tree which is known at present from the State of Pará in Brazil (*Ducke 9137, 14982, 16570*) west to the eastern rim of the Macarena Mountains near the Andean Cordillera in Colombia.

*Philipson 1647* is apparently the fourth collection from Colombia. In 1912, Ducke collected it at the rapids of Cupatí (now called La Pedrera) on the Río Caquetá, at the Colombia-Brazilian boundary. The two other Colombian collections—*Schultes 5424* and *5429*—were made in the upper reaches of the Apaporis basin, half way between the Macarena and the Cupatí localities.

*Schultes 5424* and *5429* are in fruit and were described recently as *Cynometra Zamorana* R. E. Schultes. Study of the flowering Philipson and Ducke collections has indicated the identity of the Schultes material with Huber's *Hymenaea oblongifolia.*

It is obvious that *Hymenaea oblongifolia* in eastern Colombia is associated with the ancient cretaceous outliers of the Venezuela-Guiana land mass. As such, it can not be expected to be an abundant element of the general Amazonian forest, although it may be rather common, as in the upper Apaporis basin, in the localized areas where it does occur.

The common name of *Hymenaea oblongifolia* in the State of Pará is *jutaí.* In the Comisaría del Vaupés in Colombia, it is called *coca.*

COLOMBIA: Intendencia del Meta, Río Guapaya, dense humid forest at foot of eastern slopes of Sierra Macarena; alt. 450 m. "Large tree

25 m., leaves coriaceous, shining, dark green above, sepals reddish brown, petals white." November 29, 1949, *W. R. Philipson 1647*.

**Monopteryx Uaucu** *Spruce ex Bentham* in Martius Fl. Bras. 15, pt. 1 (1862) 307.

This enormous tree, especially abundant on the proterozoic granitic shield of the Rio Negro basin, has been cited by Ducke ("As Leguminosas da Amazonia brasileira" (1939) 109) as occurring also along the lower Rios Içа (Putumayo) and Solimões, as well as in Venezuela and Colombia. I had not seen any specimens from Colombian territory, but the species was certainly to be expected in the Colombian Amazonia along the Brazilian boundary. The collection cited below establishes the occurrence of *Monopteryx Uaucu* far into Colombian territory and near the very headwaters of the Rio Negro. Many collections have been made recently in the Brazilian part of the Rio Negro valley by collectors of the Instituto Agronômico do Norte which has been much interested in the *uauçu* as an oil-tree. The seeds of *Monopteryx Uaucu* are exceedingly rich in oil and, when roasted or boiled, are edible; the oil is employed as a food as well as a fuel for lamps (La Cointe: "A Amazonia brasileira. III. Árvores e plantas utéis" (1934) 452; Ducke l.c.).

Amongst the Kuripaka Indians of the Río Guainía, *Monopteryx Uaucu* is called *ka-pĕt-oó-hĕ*.

Colombia: Comisaría del Vaupés, Río Guainía basin, Río Naquieni, at base of Cerro Monachí. "Enormous tree with buttress roots." June 1948, *Richard Evans Schultes & Francisco López 10125*.

## Euphorbiaceae

**Nealchornia japurensis** *Huber* in Bol. Mus. Goeldi 7 (1913) 298.

The type of *Nealchornia japurensis* was collected in Colombia at Puerto Córdova (above La Pedrera) on the

Río Caquetá (Japurá). *Black & Schultes 46-257* represents apparently the second record of this rare plant from Colombia. It has been found several times in the adjacent parts of the Amazon in Brazil.

A specimen of *Ule 6292* was found amongst the unidentified *Euphorbiaceae* during my recent work at Kew. It also is referable to *Nealchornia japurensis*, a species which hitherto apparently has not been reported from Perú. It will be noted that the Ule collection was made at an earlier date than the type, but it has been overlooked.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Árvore 15 m. Flor verde com cheiro de citrus." October 31, 1946, *G. A. Black & R. E. Schultes 46-257.*

PERU: Departamento de Loreto, Yurimaguas. "Baum 5–10 m. Bl. gelb. in Walde bei Yurimaguas." August 1902, *E. Ule 6292.*

**Sagotia racemosa** *Baillon* in Adansonia 1 (1860–1861) 54.

*Sagotia racemosa* Baillon var. *brachysepala* Mueller-Argoviensis in Fl. Ratisb. 47 (1864) 516.

*Sagotia racemosa* Baillon var. *genuina* Mueller-Argoviensis ibid 516.

*Sagotia racemosa* Baillon var. *ligularis* Mueller-Argoviensis ibid 516.

*Sagotia racemosa* Baillon var. *macrocarpa* Mueller-Argoviensis ibid 516.

When Mueller published the descriptions of the varietal concepts of *Sagotia racemosa*, he had available a very limited number of collections; the differences which they exhibited seemed to be significant. A study of the material now available and a comparison of the newer with the older collections shows that all of the characters upon which Mueller had based his varietal concepts are either manifestations due to age or seasonal influences or else to individual idiosyncrasies. Therefore, I am reducing the varietal epithets to synonymy under *Sagotia racemosa.*

Brazil: Estado do Pará, Lago Salgado, Rio Trombetas. Forest, August 23, 1910, *A. Ducke 11067.*—Estado do Pará, Belém. March 12, 1901, *A. Ducke 2001.*—Estado do Pará, Peixeboi, chemin de fer de Bragança. "Arataciú." August 13, 1907, *R. Siqueira 8277.*—Estado do Pará. Igarapé-assú, chemin de fer de Bragança. "Arataciú." February 6, 1903, *R. Siqueira 3343.*—Estado do Pará, Serra de Parintins. September 15, 1907, *A. Ducke 8724.*—Estado do Pará, Belém. December 11, 1914, *A. Ducke 15549.*—Estado do Pará. Distrito Acará, Thomé Assú, up Rio Acará 6 km. on river bank in forest. "Arborescent 6 m. high; white flower, *Murascaca.*" August 5, 1931, *Y. Mexia 6051.*—Estado do Pará, Belém. "Shrub 2 ft. Roots fragrant, scraped in water and used to scent clothing." December 18, 1942, *W. A. Archer 7999.*—Estado do Pará, Belém. "Tree. Root aromatic, sold in local market as perfume for bath." January 11, 1943, *W. A. Archer 8146.*—Estado do Pará, Belém. Entroncamento. "Arataciú." September 26, 1944, *A. Ducke 1635.*—Estado do Amazonas, Rio Uaupés. Ipanoré [Panuré]. "Small bushy tree, 15–20 feet. Flowers white. Caatinga."—Estado do Amazonas, Municipality São Paulo de Olivença, near Palmares. "Tree 50 feet high; trunk 4 inches diam. Terra firma; high lands." September 11–October 26, 1936, *B. A. Krukoff's 7th Exped. Brazil. Amazon. 8189.*—Estado do Amazonas, Rio Negro, Santa Izabel. November 10, 1936, *A. Ducke 341.*

British Guiana: River Quitaro. "Tree. Flowers yellow." 1838. *Schomburgk 569.*—Tributary of Habu Creek (New River). "Creek bank. Moist clay soil. A tree 40 feet high and 8 inches in diameter. (Wood preserved separately.) Small flowers in spray, both red and white on the same spray. (The white had turned to red by the time the specimens reached camp: 6 hours)." November 10, 1937, *Beddington 31.*—Basin of Kuyuivini River (Essequibo tributary), about 150 miles from mouth; dense forest. "Tree 20 m. high." November 21–26, 1937, *A. C. Smith 2539.*—Northern slope of Akarai Mountains, in drainage of Shodikar Creek (Essequibo tributary); dense forest. Alt. 300–600 m. "Tree 35 m. high." January 10–20, 1938, *A. C. Smith 2905.*—Moraballi Creek, River Essequibo. "30′ undergrowth tree in mixed forest, rather ropy on rock slope, bark grey, smooth; slash similar to *Sandwithia guyanensis.* ♂ flowers paired on long stalks, calyx green, glabrous; corolla white, stamens °° white; ♀ flowers green perianth, leaf-like ovary trigonal; stigma 6-partite, rayed." October 14, 1939, Field No. (Forest Dept. Brit. Guian.) *F. 273, Record No. 3009.*

Dutch Guiana: No precise locality, no date. *Hostmann 1156.*—No precise locality. "*Cacaoballi,*" May 1945, *Zanderij 311.*

French Guiana: No precise locality, no date. *Martin 27.*—No precise locality. 1840, *H. F. Talbot s.n.*—"Environs de Godebert." December 20, 1920, *Wachenheim s.n.*

VENEZUELA: Territorio del Amazonas. "In ripis fl. Pacimoni. Arbor subramosa, tenuis, 15–20 pedalis. Monoica. Flores ♂ albi, odorati. Fls. ♀ virides." February 1854, *R. Spruce 3342*.

## Senefeldera contracta *R. E. Schultes sp. nov.*

Arbor usque ad sexaginta pedes alta, in sylvis crescens. Truncus robustus. Ramuli glabri ut videtur, cortice rufo obtecti. Folia valde coriacea, elliptica, petiolata (petiolis robustis, 3.5–8 cm. longis, usque ad 0.5 cm. in diametro), apice obtusa vel obscure acuta, basi rotundata, obscure biglandulosa, leviter marginata, glabra, sicco stramineo-fusca, nervo centrali robusto subtus valde elevato supra non conspicuo, nervis secundariis quattuor-vel quindecim, 23 31 cm. longa, 9.5–12.5 cm. lata. Inflorescentiae stamineae erectae, subpaniculatim ramosae, 19–27 cm. longae, axibus centralibus omnino glabris, bracteis ovato-ellipticis, magnis, 10 mm. longis. Flores flavi, tres staminiferi in axilla bracteolae parvae, atroviridis, suborbicularis vel subtriangularis, irregularis cum margine eroso-hyalino, circiter 1.7 mm. longae, 2 mm. latae (sed bracteolae inter se multo variabiles), perianthio 0.5 mm. longo, obtuse trilobato, glabro, staminibus quindecim minoribus, filamentis 0.1–0.2 mm. longis, liberis, antheris flavis, subglobosis, 0.25 mm. altis, 0.30 mm. latis. Fructus adhuc ignotus.

*Senefeldera contracta* may be distinguished from other species by the very large size of the leaves, their coriaceousness and high lustre on both surfaces; by the unusually stout petioles; by the large number of stamens; and especially by the extremely contracted (not loose and much-branched) inflorescence. In the size of the leaves, *Senefeldera contracta* resembles *S. macrophylla* Ducke, but the latter differs obviously from the former in the shape and dullness of the leaves, in the more slender petioles and in having a long, lax and much-branched inflorescence. Like *Senefeldera contracta*, *S. nitida* Croizat is

very lustrous, but its leaves are very much smaller and its inflorescence is very dissimilar. The flowers of *Senefeldera nitida* are unknown, so it is not possible to evaluate the relationship of this species with *S. contracta;* it is not unlikely that these two are rather closely allied. *Senefeldera contracta*, with fifteen stamens, is approached by *S. dodecandra* with twelve; but a number of vegetative and floral characters indicate that no relationship exists between the two.

COLOMBIA: Comisaría del Amazonas, entre Leticia y El Marco. "Virgin Forest. Tree 30 meters; trunk stout; flowers small." August 20, 1946, *George A. Black & Richard Evans Schultes 46-36* (TYPE in U.S. Nat. Herb.).

**Senefeldera inclinata** *Mueller-Argoviensis ex Martius* Fl. Bras. 11, pt. 2 (1874) 530.

The collection cited below appears vegetatively to match rather closely the type of *Senefeldera inclinata* which is a fruiting specimen from the region of the Casiquiare. This species has apparently not hitherto been reported as an element of the flora of Colombia.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, Leticia. "Bush, 3½ m.; Flowers greenish-white." August 16, 1946, *George A. Black & Richard Evans Schultes 46-4.*

## SAPINDACEAE

**Paullinia Yoco** *R. E. Schultes & Killip ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 10 (1942) 302, t. 27.

In 1942, world conditions prevented my consulting the specimens of yoco which were collected in Colombia in 1923 by the Belgian botanist Florent Claes. Mention was made (Schultes l.c. 309) of this material and the fact that De Wildeman (in Compt. Rend. 183 (1926) 1350) had identified yoco as *Paullinia scarlatina* Radl. from this material.

When I visited Belgium in 1950, I was fortunate in being able to examine Claes' material, preserved in the

herbarium in Brussels. Claes made several collections of the plant from which the Indians prepare yoco. Of these, one (*Claes 30*) is in excellent flower, one (*Claes 24*) has partly disintegrated remains of flowers, and two are sterile. There is an appreciable variation in leaf size, but all of the collections may be referred without hesitation to *Paullinia Yoco*. The flowering specimen (*Claes 30*) has the smallest leaves and is the specimen which De Wildeman has annotated as representing *Paullinia scarlatina*. It has the same characteristic short, stiff inflorescence as the type. *Claes 24* has much longer inflorescences, but the same woody tendrils as the type. The other specimens had no determinations, but I have annotated all the material as *Paullinia Yoco*.

There apparently is no information on the Claes specimens relative to the different "kinds of yoco" to which Zerda Bayon, Klug and Schultes have referred (cf. Schultes l.c. 311).

Through the kindness of Professor W. Robyns, director of the Brussels Herbarium, I was able to obtain an excellent biographical article on the life and work of the late Florent Claes. Claes, it would seem, carried out rather extensive explorations for plant introduction. The vast amount of work which he did has certainly not received merited notice. For this reason, I am calling attention to the article which appeared in a publication not widely circulated, at least in the New World: L. Pynaert: "Florent Claes: Botanist belge, explorateur," Publication de botanique d'Agrément, Bulletin mensual de documentation de botanique horticole et d'horticulture pratique (Régions tempérées et tropicales) (1937) Bruxelles. Pynaert's article reviews in some detail much of the work which Claes accomplished during his several trips to Colombia and considers the discovery of yoco at length (l.c. 44–46).

Colombia: [Comisaría del Caquetá, Río Orteguaza], 1923, *Claes 12, 23, 24, 30.*

## Bombacaceae

### Bombax sordidum *R. E. Schultes sp. nov.*

Arbuscula parva, usque ad tres pedes alta, a *Bombace coriaceo* foliis coriaceoribus, majoribus, margine magnopere revolutis, infra densissime et sordide pulveraceis cum pilis fulvis et fructibus aliquid majoribus differt. Flores adhuc ignoti.

The collection *Schultes & López 9342*, first identified as *Bombax coriaceum* Mart. & Zucc., but shown by later studies to be distinct, represents one of the most curious species of the genus. Most closely allied to *Bombax coriaceum*, which it resembles in its diminutive bushy habit, *B. sordidum* can be distinguished by its larger and much more coriaceous and more marginate leaves, which are densely clothed beneath with a very dark brown, dust-like indumentum, and by its larger capsules.

The distribution of *Bombax coriaceum* as given by Schultes (in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 303) must be slightly modified to accord with this new disposition of the collection cited below. *Bombax coriaceum* is, so far as we now know, confined to cretaceous quartzitic areas in Amazonian Colombia and apparently does not occur, as does *B. sordidum*, on the proterozoic granitic shield. The two species are, however, very closely allied.

Colombia: Comisaría del Vaupés, Río Negro, El Castillo or San Felipe, near confluence of Ríos Guainía and Casiquiare. Caatinga. "Low shrub, 3 feet tall. Leaves very coriaceous." December 12, 1947, *Richard Evans Schultes & Francisco López 9342.*

## Sterculiaceae

### Herrania albiflora *Goudot* in Ann. Sci. Nat., sér. 3, 2 (1844) 230, t. 5, figs. 1–10.

In June 1950, when I visited the Jardín Botánico de Madrid, it was my exceedingly great pleasure to see the famous Mutis water-colors of Colombian plants, made by the artists of the Expedición Botánica which investigated the flora of Colombia under the direction of Celestino Mutis from 1783 to 1808.

Amongst the six thousand plates, there are several extraordinarily artistic and accurate illustrations representing species of *Herrania*. These plates, labelled simply "Theobroma" by the artists, are all included in Volume No. 28 under number 5333. They were determined as the several concepts of *Herrania* by Triana who annotated each plate in his own hand in pencil and signed his annotations. It is of great interest to recall that these plates were made about half a century before the genus *Herrania*, and the three species so beautifully represented by the Mutis plates, were described by Goudot in 1844.

One of the plates represents a fruiting and flowering branch of *Herrania albiflora*. Not only are ripe and unripe fruits shown in excellent detail, but a large number of flowers are depicted so painstakingly that it is clear that Mutis was able, so long ago, to differentiate between the patelliform calyx of *Herrania albiflora* and the subcymbiform calyx of the other species illustrated. No foliage is drawn on the plate of *Herrania albiflora*. Triana correctly annotated this plate as "*Herrania albiflora* Goudot."

In the Mutis collection of plants in Madrid, there is a sterile collection of leaves, misidentified as "*Theobroma Mariae*," which also represent *Herrania albiflora*. They undoubtedly belong to the plant the flowers and fruits of which are portrayed on the Mutis plate of *Herrania albiflora*.

COLOMBIA: *Exped. Bot. Mutisii Novae-Granat.* (1783–1808) *3759*.

We have always presumed that the type of *Herrania albiflora*, the type-species of the genus, was preserved in the herbarium at Paris. In June 1950, however, I found Goudot material at Geneva which may very well be the type of *Herrania albiflora.*

In Geneva, there are three sheets representing the Goudot collection of this species, all labelled, in Goudot's handwriting, "C. N. 1 *Herrania albiflora* mihi. Annales Sc. nat. 1844. Muzo." One sheet has several very young and membranaceous leaves and an envelope in which there are fragments of a fruit belonging possibly to an annonaceous plant and which, by some error, have been associated with the *Herrania* collection. Another sheet has a complete and mature leaf. The third sheet has three envelopes: one contains several seeds of *Herrania albiflora;* another has a few flowers and a very young capsule; the third has a flower completely dissected with the parts glued flat to the envelope.

An examination of these floral parts and of Goudot's description and drawing of *Herrania albiflora* lead me to the conclusion that, at least for the flowers and fruit, the Geneva material is the type of the species and genus.

How has it been possible for Goudot type material to find its way to Geneva? There are, of course, many Goudot collections in the Delessert Herbarium (cf. A. Lasègne: "Musée Botanique de M. Benjamin Delessert" (1845) 471).

It may be of interest to note that a comparison of the Goudot floral dissection with the description of *Herrania albiflora* has uncovered several minor discrepancies or omissions. The sepals, described as glabrous within, have a very minute and sparse puberulence on the lower portion of the inner surface; and the petals are extremely muricate-granulose externally, as are also the very short ligules in the basal portion near their junction with the petal.

COLOMBIA: Departamento de Cundinamarca, Muzo, 1825, *J. Goudot sine num.*

**Herrania breviligulata** *R. E. Schultes* in Caldasia (1942) 19.

*Herrania breviligulata* was described from flowering material collected in the Putumayo of Colombia in 1941. Hitherto, no additional material has been available for study. In July 1950, I found the collection *Mexia 7328* in the Riksmuseet in Stockholm. Although, unfortunately, it is nearly sterile (having only a few loose seeds), the collection can be referred, on the basis of very specific vegetative characters, to *Herrania breviligulata*. The Provincia de Napo-Pastaza is adjacent to the Colombian Comisaría del Putumayo, but the known distribution of the species is extended to include an additional drainage-area.

ECUADOR: Provincia de Napo-Pastaza, near Archidona. Alt. 650 m. "Dense forest. Erect shrub, 2–5 m. high. Fruit green, deeply ribbed." No date. *Ynes Mexia 7328.*

**Herrania kanukuensis** *R. E. Schultes* in Caldasia 2 (1943) 11; in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 227; ibid 14 (1950) 126, t. XXXIII.

*Theobroma Mariae* (Mart.) Decaisne ex Goudot var. *lobata* Pulle in Rec. Trav. Bot. Neérl. 9 (1912) 151.

In 1943, I described *Herrania kanukuensis*—extraordinarily distinct in the form of its fruit—from a collection from southern British Guiana. Recently, a sterile collection referable to this species was reported from an adjacent part of the Territorio do Rio Branco in Amazonian Brazil (in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 126). In May 1950, while engaged in taxonomic studies in the Botanisch Museum en Laboratorium at the University of Utrecht, Holland, a large series of collections representing this species was kindly made available to me for examination.

In 1932, Uittien (in Pulle: Fl. Surin. 3 (1932) 44) reduced *Theobroma Mariae* var. *lobata* to synonymy under *Th. Mariae*, identifying all of the then available material from Dutch Guiana as representing this Amazonian concept. In 1943, it appeared to me that the Surinam *Theobroma Mariae* var. *lobata* represented the concept described by Schomburgk from nearby British Guiana as *Lightia lemniscata*, and I placed it in synonymy under *Herrania lemniscata* (Schultes in Caldasia 2 (1943) 13), a species with remarkably lobate leaflets. During the war, the Utrecht material was unavailable, but my recent studies have convinced me that *Theobroma Mariae* var. *lobata* and *Herrania kanukuensis* represent the same concept.

From the numerous collections, for the most part from Surinam, it is now obvious that *Herrania kanukuensis* is both a widespread and, at least locally, an abundant element of the flora of Surinam, eastern British Guiana and the adjacent rim of northern Brazil.

Dutch Guiana: Am oberen Corantijne-fluss. December 27, 1910, *J. F. Hulk 26* (Type of *Theobroma Mariae* var. *lobata* in Herb. Utrecht); River Coppename, "*Maripoele kakaoeleo.* Herrania. Vrucht eetbaar. Eerste doorsteek," November 6, 1916, *J. W. Gonggrijp 2565;* River Corantijn, Kaurikreek. "Onvertaktboompje 3–5 m. hoog met armdikken stam en cauliflore vruchten," June 20, 1916, *J. W. Gonggrijp 2111;* River Corantijn, Kaurikreek, "*Maipoelie doron doron* (Kar.). Boompje 5 m. hoog onvertakt Blm. donker purperrood." November 22, 1916, *Stahel & Gonggrijp 3015;* Placer L'Aiva, October 31, 1918, *J. W. Gonggrijp 4126;* Flum. Marowijne, November 20, 1918, *J. W. Gonggrijp 4101;* River Tapanahonie, Jaikreek. November 17, 1918, *J. W. Gonggrijp 4117;* River Marowijne, hill forest near Amerikan Kondre. "Boompje; groen op stam. *Boscacao.*" February 21, 1949, *J. Lanjouw & J. C. Lindeman 2304.*

**Herrania laciniifolia** *Goudot ex Triana & Planchon* Fl. Novo-Granat. (1862) 209, *nomen subnudum;* García-Barriga in Caldasia 1, No. 2 (1941) 55, t. 1, 4.

In the collection of Mutis plates preserved in Madrid,

there are several illustrations representing *Herrania laciniifolia*. These are all in black and white, not in color. One plate has a leaf with one complete leaflet and a length of stem with several flowers and buds; another plate has analytical drawings of the flowers and fruits; a third has analyses only of the floral parts.

The Mutis specimen in Madrid (cited below) is sterile, but it is undoubtedly from the tree from which the plate was made. In view of the scarcity of collections of *Herrania laciniifolia*, it is unfortunate that a definite locality for the Mutis collection is not available. Both the specimen and the plates agree perfectly with the type and later material of this remarkable species.

COLOMBIA: *Exped. Bot. Mutisii Novae-Granat.* (1783–1808) 937.

**Herrania nitida** (*Poepp.*) *R. E. Schultes* in Caldasia 2 (1943) 16, t. p. 17.

*Herrania atrorubens* Huber in Bull. Soc. Bot. Genève, sér. 2, 6 (1914) 187.

Early in my study of the genus Herrania, I published (in Caldasia 2 (1944) 329) a note pointing out that without an examination of the type of Huber's *H. atrorubens*, it was not possible to evaluate the validity of the concept and that "the colour character alone would hardly suffice for the creation of a new specific concept."

Now, having completed an extensive study of the classical material of the genus, I have been unable to locate the type of *Herrania atrorubens*. One would expect it to be preserved in the Museu Goeldi in Belém do Pará or in the Herbier Boissier in Geneva, but a search in these two institutions, as well as in other Brazilian and European herbaria, has not uncovered Huber's material.

From an evaluation of the meager characters given by Huber and from the geographical data given for the type collection, *Herrania atrorubens* may, it would seem, in

the light of experience gained during the study of a wide range of material, safely be referred to *H. nitida.*

**Herrania pulcherrima** *Goudot* in Ann. Sci. Nat. sér. 3, 2 (1844) 232, t. 5, figs. 11–12.

In the collection of Mutis plates, there is a most strikingly beautiful and accurate water-color of a section of a stem of *Herrania pulcherrima* in full flower. A number of diagnostic characters of *Herrania pulcherrima* are most clearly shown: the congested, many-flowered inflorescences; the very abbreviated pedicels; and the long and membranaceous ligules with alternate scarlet and whitish bands. Of this colored plate, there are two copies in black and white. No foliage seems to have been drawn.

A search in the Mutis collection of plants in Madrid has failed to produce a specimen of *Herrania pulcherrima.*

**Herrania purpurea** (*Pitt.*) *R. E. Schultes* in Caldasia 2 (1944) 333.

Further collections of *Herrania purpurea* in the Urabá area of Antioquia emphasize the great abundance of this Middle American species in the northwesternmost corner of the South American continent.

COLOMBIA: Departamento de Antioquia, Municipio de Pavarandocito, Villa Arteaga. "Small tree 8 feet tall." December 1948, *Richard Evans Schultes & Francisco López 10464.*—Departamento de Antioquia, Municipio de Pavarandocito, Pavarandocito and vicinity. October 1950, *Gabriel Gutiérrez V. 2000.*

## DILLENIACEAE

**Saurauia pruinosa** *R. E. Schultes sp. nov.*

Arbor frondosa, usque ad viginti quinque vel triginta pedes alta. Ramuli teretes, brunneo-cinerei, maxime densissime et grossiuscule echinato-setosi (setis ipsis albido-scrobiculatis) atque inter setas densissime pilis minutis roseo-niveis aloeformibus vestiti. Folia valde coriacea, siccitate fragilia, 22–31 cm. longa, 6.5–12 cm.

lata, elliptica, apice longe acuminata, basi rotundata, margine minute et regulariter denticulata, supra atro-viridia et densiore praecipue venas versus aspero-setosa, subtus densissime et molliter praecipue prope venas cinereo-echinato-setulosa et maxime densissime lanato-tomentosa cum pilis roseo-niveis aloeformibus vel dendriformibus. Petioli robusti, teretes, 2–3.5 cm. longi, 4 mm. in diametro, ramulorum indumento vestiti. Inflorescentiae magnae, foliis subaequales, usque ad 25 cm. longae, 15 cm. latae, ramulorum indumento sed colore cinereo-roseo omnino obtectae; rhachide centrali robustissima, 5–6 mm. in diametro. Bracteae subulatae, usque ad 1 cm. longae, intus brunneo-setulosae, extus rhachidis indumento vestitae. Alabastra globosa, usque ad 1 cm. in diametro, roseo-tomentulosa. Flores numerosiores, maximi (usque ad 3.3 cm. in diametro) et pulcherrimi, valde aromatici, fragrantes. Sepala quinque, rosea et alba, inaequalia, chartacea, ovato-elliptica, apice obtusiuscula; tria majora 10–11 mm. longa, 8–9 mm. lata, extus roseo-albida minute lanato-tomentulosa cum pilis aloeformibus et cum carina centrali setarum roseo-brunnearum armata; duo minora usque ad 10 mm. longa, 7–8 mm. lata, extus omnino setis roseo-brunneis (setis ipsis cum appendicibus setuliformibus dense vestitis); omnia intus magnopere dense tomentulosa pilis albis lanato-aloeformibus, basim versus vulgo glabra sed prope insertionem cum pilis aureis vestita. Petala quinque, alba, aequalia, membranacea, rotundato-obovata, integra vel saepe apice aliquid incisa, utrinque glabra. Stamina plusminusve centum sexaginta, filamentis debilibus, 4 mm. longis, antheris flavis, 1.5 mm. longis. Ovarium perfecte globosum, 5–6 mm. in diametro, glabrum, quinque (rarenter sex) cum stylibus carnosis, usque ad 6 mm. longis, stigmate capitato.

Although *Saurauia pruinosa* resembles *S. brachybotrys* Turcz. and *S. Spraguiana* Busc. in some respects, it can

be distinguished at once from these and all other species by its extraordinary number of stamens. *Saurauia brachybotrys* has about sixty and *S. Spraguiana* from sixty to eighty stamens; *Saurauia pruinosa*, with one hundred and sixty stamens, has the highest number among the American species of the genus. *Saurauia pruinosa* may also be distinguished from most other American species by the peculiar hoary indumentum which has a beautiful rose-pink bloom.

*Saurauia pruinosa* appears to be most closely allied to *S. roseotincta* R. E. Schultes of Perú. The latter species, like the former, has a very high number (130) of stamens and has a beautiful pink-pruinose indumentum on the under surface of the leaves. It differs in number of stamens; in having an inflorescence subequal to (not shorter than) the leaves; in having flowers only half as large; and in several floral characters.

COLOMBIA: Comisaría del Putumayo, Valley of Sibundoy, Sibundoy. Altitude about 2225–2300 m. *Moquillo*. Flowers excessively narcissus-fragrant. Petals white; hairs on sepals pink. Leaf hairs pink, especially on young leaves. Leaf backs and young branches a tawny ash-brown, giving peculiar characteristic appearance at a distance — the two colours of hair. Fruit ripens red. Flower buds large." May 29, 1946, *Richard Evans Schultes & Mardoqueo Villarreal 7651* (TYPE in Herb. Gray).

**Saurauia roseotincta** *R. E. Schultes sp. nov.*

Arbor gracilis, quindecim ad viginti pedes alta. Folia subcoriacea, elliptica, margine minutissime denticulata, apice subacuta, basi cuneata, 21–34 cm. longa, 7–11 cm. lata, supra bulbata, nervos versus et sparsiore in lamina aspero-setosa, subtus tactu mollia, omnino minutissime albo-stellato-pilosa atque in nervis omnibus densius roseo-stellato-pilosa; petiolus robustus, usque ad 3.5 cm. longus, 4–5 mm. in diametro, grossiuscule rufo-ferrugineo-setosus. Inflorescentiae quam folia breviores, usque ad 20–22 cm. longae, plusminusve viginti-florae, partibus

omnibus rufo-ferrugineo-setulosae. Bracteae setoso-pilosae, subulatae, usque ad 5 mm. longae. Flores non numerosi, 13–14 mm. in diametro. Sepala quinque; interiora rhomboideo-ovata, apice obtusa, extus setarum carina mediana armata, intus prope apicem dense pulverulenta, basi glabra, 9–10 mm. longa, 9–10 mm. lata; exteriora crassiora, elliptico-ovata, apice subacuta, extus densissime et grossiuscule aureo-setosa, intus pulverulenta sed basi glabra, 9–10 mm. longa, 5–6 mm. lata. Petala membranacea, alba, rotundata, margine subintegra (leviter subundulata ut videtur), 6–7 mm. longa, 5–6 mm. lata. Stamina plusminusve centum triginta, antheris parvis, 0.7 mm. longis, filamentis 2–3 mm. longis, basi rufo-setoso-barbatis. Ovarium globosum, 4 mm. in diametro, glabrum, quinque cum stylibus usque ad 1.5 mm. longis.

*Saurauia roscotincta* very closely resembles *S. pseudoruiziana* Busc., *S. Ruiziana* Steud., and *S. tomentosa* Spreng., from which concepts it may be immediately distinguished by having 130–140 stamens instead of 80, 30–40 and 40–70 respectively. There are also differences to be noted in the pilosity of the leaves and in the size of the floral parts.

There are a number of notes appended to the type specimen. These were made by Dr. E. P. Killip when he compared the specimen with material at Kew and in Berlin. Killip wrote: "Aff. *tomentosa*, but hairs yellow, not white. Aff. *Ruizana* [sic], but that has long soft, appressed hairs above, and on nerves beneath; flowers very similar. [Notes at Berlin.] Aff. *pseudruizana* [sic] but leaves here are more bullate and without long appressed hairs of *pseuoruizana*. [Notes at Kew.] This agrees well with description of *Ruizana* var. *Weberbaueri* Busc. in Monagr.; perhaps, though, it is a distinct species. (Oct. 1925)."

According to the collector's data, the pubescence of

the under surface of the leaves was pink-red in life. In the dried specimen, it has changed to a rich golden rust-color. It is probable that the finest of the stellate hairs (that is, those on the blade itself) were, in life, whitish as they are in the dried material and that the coarser stellate hairs along the primary, secondary and tertiary nerves (now rust-colored, but in places still pinkish) were responsible for the general hue of redness. The specific epithet refers to this beautiful character of the under surface of the leaf.

PERU: Chaglla. Alt. about 9,000 ft. "Slender, open, 15–20 ft. tree; leafy only above. Pubescence lower sides leaves pink-red; flowers white." May 12, 1923, *J. Francis Macbride 3652* (TYPE in U.S. Nat. Herb.).

## OCHNACEAE

### Leitgebia colombiana *R. E. Schultes sp. nov.*

Fruticulus usque ad 4-pedalis, parce fastigiato-ramosus. Caules nigri, basi 8–10 mm. in diametro, praeter apicem denudati, foliorum delapsorum cicatricibus 1.8–2.2 mm. distantibus asperati, superne stipulis elongato-triangularibus, 3 mm. longis, 1 mm. latis, pectinato-fimbriatis, extus striatis et subcarinatis, sublignosis, persistentibus, nigrescentibus et irregulariter ferrugineo-setulosis, erecto-amplectentibus. Folia caulem prorsus velantia, coriacea, lanceolato-elliptica, plerumque 10 mm. longa, 3–3.5 mm. lata, apice obtusa sine mucrone glanduloso, basi attenuato-cuneata, margine callosa et valde revoluta, remotissime et obscure subundulato-denticulata (utroque margine cum sex vel septem denticulis glandulosis), supra lucida, nervo medio et sex ad novem nervis secundariis densis obliquis prominentioribus, subtus pallidiora minusque lucida, praeter nervum medium prominulum apparenter avenia. Flores solitarii, inter folia summa subimmersi, 5–6 mm. in diametro, bibracteolati. Pediccllus 1 mm. longus. Bracteolae oppositae, subulatae, margine

omnino irregulariter fimbriolatae, circiter 3 mm. longae sed saepe leviter inaequales. Sepala quinque hyalino-membranacea, omnino glabra, ovato-lanceolata, 3 mm. longa, 1 mm. lata, apice longe acutissima, margine integra, valde concava. Petala quinque, tenuiter membranacea, ovata, circiter 3 mm. longa, basi 1.5 mm. et apice 1 mm. lata, apice rotundata, margine integra, nervis numerosis percursa, basi alba, apicem versus violacea. Staminoidea quinque, petaloidea, membranacea, concavo-oblonga (non spathulata), apice rotundata, circiter 3 mm. longa, 1.5 mm. lata, rosea, nervo medio prominentiore. Stamina quinque, antheris linearibus, flavis, usque ad 1.8 mm. longis, ad basim staminodei filamento brevissimo coalita. Ovarium subtriangulari-ovoideum, 0.8 mm. longum, stylo filiformi 3 mm. longo, stigmate obtuso coronatum. Fructus adhuc ignotus.

*Leitgebia*, a genus hitherto unknown from Colombia, is characteristic of the isolated mountains of the Venezuelan-Guianan land-mass.

The type and, until very recently, the only known species was *Leitgebia guianensis* Eichler, from Mount Roraima and from Mount Duida. Oliver described a concept from British Guiana as *Leitgebia Imthurniana*. Later, Gleason made this the type of a new genus: *Roraimanthus*. Recently it has been placed in the genus *Sauvagesia* by Dwyer.

In 1945, Lasser (in Bol. Acad. Ciénc. Fís. Matem. Nat. Caracas (1945) 246, fig. p. 247), described *Leitgebia Gleasoniana* from Mount Duida and Mount Paraque in southern Venezuela; this species is at once distinguished from *Leitgebia guianensis* by its leaves which, measuring 18–20 mm. by 2 mm., are twice as long as those of the earlier species.

*Leitgebia colombiana* appears to approach most closely to *L. guianensis*, from which it can be distinguished at

once by having the leaves much less dense and much less closely appressed around the stems; where the leaves have fallen, the scars are less conspicuous and are more distinctly placed on the stem. The former has the stipules much less conspicuous and spreading than the latter; and it has flowers which are only half as large; slightly larger leaves which are more nearly lanceolate-elliptic (not oblanceolate) and remotely and obscurely subundulate-denticulate along the entire margin (instead of closely and definitely sharp-dentate along the upper half of the margin only); petals which are apparently non-deciduous, ovate or broader at the base than at the apex (instead of conspicuously obovate); and sepals which are entire (not serrulate) near the apex.

The fruit of none of the three species of *Leitgebia* is known. *Leitgebia colombiana* flowers on Mount Chiribiquete in May and sets fruit probably from October to December. I collected at this locality in May, July, and January and was unable to find fruiting material of this curious shrub.

COLOMBIA: Comisaría del Vaupés, Macaya-Ajaju River confluence, Mount Chiribiquete. Quartzite base. Summit 800–1200 feet above forest floor; 1700–2100 feet above sea-level. "Small shrub. Flowers pinkish." May 15–16, 1943, *Richard Evans Schultes 5479* (TYPE in Herb. Gray).

## COMBRETACEAE

**Combretum laxum** *Jacquin* Enum. Pl. Carib. 19 (1760) 115.

*Black & Schultes 46-293* represents the same variant of the widespread and variable *Combretum laxum* which occurs in adjacent parts of Amazonian Perú and which was recently reported from the Río Igaraparaná in Amazonian Colombia (Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1949) 40).

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Trepadeira.

Flores brancas, cheirosas," November 2, 1946, *G. A. Black & R. E. Schultes 46-293*.

**Combretum rotundifolium** *L. C. Richard* in Act. Soc. Hist. Nat. Paris 1 (1792) 108.

One of the most common riverine lianas in Amazonian Colombia, *Combretum rotundifolium* has not been frequently collected there; *Schultes 3984* is apparently but the second collection reported in the literature. The first (Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 135) was from the distant Apaporis River basin.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, between Quebrada Menaje and Río Putumayo. Alt. 150–170 m. "Fruit fiery red. Bush." June 15–17, 1942, *Richard Evans Schultes 3984*.

**Combretum Wandurraganum** *R. E. Schultes sp. nov.*

Frutex scandens, extensus, robusto cum trunco et ramis glabris laevibus teretibusque et ramulis fusco-lepidotis. Folia chartacea, elliptica vel subovata, apice abrupte acuminata, basi rotundata, integra, statu adulto 7–17 cm. longa, 4–8 cm. lata, supra nitidula, subtus vivo aureo-lepidota, venis secundariis plerumque novem subtus aliquid conspicuis. Paniculae axillares, apparenter densiflorae, plerumque usque ad 24 cm. longae, rhachidibus robustioribus 4 mm. in diametro, dense fusco-lepidotis. Flores adhuc ignoti. Samarae pulchrae, atrosanguineae, quadrialatae, orbiculares, plerumque 2.2–2.4 cm. latae (alis computatis), plusminusve 2–2.2 cm. altae, longe et graciliter stipitatae (stipitibus 10–12 mm. longis, dense lepidotis), omnino sparsissime lepidotae.

*Combretum Wandurraganum* resembles most closely perhaps *C. rotundifolium* Rich., from which it can be distinguished by differences in the size and shape of the leaves; in the color and density of the lepidote indumentum on the under surface of the leaves; and, most

strikingly, by the peculiar round shape of the long-stipitate samara.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, Loretoyacu River. Alt. about 100 m. "Extensive vine. Fruit red." September–November 1944, *Richard Evans Schultes 6070* (TYPE in Herb. Gray).

## STYRACACEAE

**Styrax Tessmannii** *Perkins* in Notizbl. 10 (1928) 459.

This species, described from material collected along the Río Ucuyali in the Departamento de Loreto, Perú, has hitherto not been reported from Colombia. *Schultes 7144* has larger leaves than those described from the type, but all other reported characters appear to agree.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, Amazon River watershed, Loretoyacu River. Alt. about 100 m. "Small tree on highland," March 1946, *Richard Evans Schultes 7144*.

## APOCYNACEAE

**Couma utilis** (*Mart.*) *Mueller-Argoviensis* in Martius Fl. Bras. 6, pt. 1 (1860) 19, t. 5.

The collections cited below are apparently the second and third known from the Comisaría del Vaupés in Colombia (J. Monachino in Lloydia 6 (1943) 237, ibid 9 (1946) 301). It would seem that this species is associated only with the granitic "Brazilian shield" portion of eastern Colombia. It is known also from the Amazon of Brazil (especially the Rio Negro and Rio Madeira basins) and Venezuela.

COLOMBIA: Comisaría del Vaupés, Río Negro, Cocuí. "*Sorva*. Columnar tree, $2\frac{1}{2}$ feet in diameter, 75 feet tall. In flood-bank. Bark very thick, smooth but checked outside, grey and black, soft, reddish inside. Latex extremely thick, abundant, white, very sticky. Leaves dark green above, pale beneath. Flowers fragrant, pinkish to white." December 26, 1947, *Richard Evans Schultes & Francisco López 9467*.—Same locality and date. "Small columnar tree, $1\frac{1}{2}$ ft. diameter, 50 feet tall. Crown wide. Flowers pink, fragrant. Latex very abundant, thick, white. Bark smooth, black-grey." *Schultes & López 9485*.

**Malouetia Tamaquarina** (*Aubl.*) *A. de Candolle* Prodr. 8 (1844) 378.

*Malouetia Tamaquarina*, widespread in Amazonian Brazil and in the Guianas, occurs in heavy densities in the trapecio amazónico of Colombia. It inhabits the low flood-land or *rebalsa* accompanying *Hevea brasiliensis* (Willd. ex Juss.) Muell.-Arg. It has an extremely abundant white latex which, according to persistent reports, was formerly used as an adulterant of *Hevea* rubber. The Peruvian name *cuchara-caspi* ("spoon-tree") is used by the inhabitants of the trapecio; the name refers to the custom of making spoons and other utensils from the soft, white wood of the treelet.

The ripe fruit of *Malouetia Tamaquarina* forms, in season, a major part of the diet of the *pajuíl*, a bird native to the region. There is a widely accepted belief in the upper Amazon that the bones of the *pajuíl*, at the time of abundant fruiting of the *cuchara-caspi*, are highly poisonous to dogs who may obtain and eat them. The poisoning agent is held to be the fruit. Such a generally accepted belief is, indeed, worthy of phytochemical investigation.

COLOMBIA: Comisaría del Amazonas, trapecio amazónico, Loretoyacu River. Alt. about 100 m. "Small tree. Flowers white. *Cuchara-caspi*." September–November 1944, *Richard Evans Schultes 6083*.

## VERBENACEAE

**Citharexylum Ulei** *Moldenke* in Fedde Repert. Sp. Nov. 37 (1934) 237.

This collection provides the first record of the Brazilian *Citharexylum Ulei* from Colombia. It is shown, through the collection cited below, to occur right up to the base of the Andes in Colombia.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Asís. March 9–10, 1942, *Richard Evans Schultes 3388*.

**Datura suaveolens** *Humboldt & Bonpland* in Willdenow Hort. Berol. (1809) 227.

This species, native apparently in southeastern Brazil, is widely cultivated in the New World tropics. Amongst the Kofán Indians on the Colombian-Ecuadorian border, an infusion of the leaves is said to be taken occasionally as a narcotic. It is known to the Kofánes as *ku-a-vá-u*, which, translated, signifies "pink Datura." The *Datura arborea* L., which has large white flowers but which the Kofánes apparently do not like to use as a narcotic because "it is too poisonous," is called *tu-to-a-vá-u*, literally "white Datura."

ECUADOR: Río San Miguel o Sucumbíos, entre el Río Putumayo y la Quebrada Teteyé. Alt. 260 m. "From Inga Indian garden. A narcotic. Kofán name: *ku-a-vá-u*," March 29, 1942, *Richard Evans Schultes 3472*.

BIGNONIACEAE

**Arrabidaea Fanshawei** *Sandwith* in Bull. Torr. Bot. Club 75 (1948) 662.

*Schultes 5394* represents, according to Sandwith, a form of the British Guianan *Arrabidaea Fanshawei* "with leaflets persistently tomentellous beneath." Its presence in eastern Colombia once more emphasizes the relationship of the flora of the upper Apaporis basin with that of the Venezuelan-Guianan area.

COLOMBIA: Comisaría del Vaupés, Río Macaya, between Río Apaporis and Cachivera del Diablo. "Extensive vine. Flowers purple, covered with an ashy puberulence (?). Basal diameter of vine 4 inches. Bark rough, brown at base. Leaves pale ashy green beneath, glossy dark green above." May 15–16, 1943, *Richard Evans Schultes 5394*.

**Arrabidaea xanthophylla** *Burret & K. Schumann* in Martius Fl. Bras. 8, pt. 2 (1896) 70.

The yellowish leaves of this vine, which is rather common in the trapecio amazónico of Colombia, are made

into an infusion and used by the Tikuna Indians as an eye-wash in the treatment of the severe conjunctivitis which often spreads throughout the area in epidemic form. The Tikunas call the plant *káh-pĕ-ree*. This species is especially well represented in herbaria from eastern Perú.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu (Lago de Socó). "Vine. Flowers yellow." November 1945, *Richard Evans Schultes 6798*.

**Paragonia pyramidata** (*Rich.*) *Burret* in Vidensk. Meddel. 1893 (1893) 104.

*Paragonia pyramidata*, rather widespread in tropical America, is a conspicuous element of the flora of the upper Apaporis basin.

COLOMBIA: Comisaría del Vaupés, Río Macaya, vicinity of Cachivera del Diablo and mouth of river. "Vine. Flowers purple." May 1943, *Richard Evans Schultes 5498*.

## ACANTHACEAE

**Mendoncia lasiophyta** *Leonard sp. nov.*

Suffrutex volubilis, grandis, caulibus subquadrangularibus, sursum dense pilosis, pilis fulvis adscendentibus usque ad 4 mm. longis, deorsum glabratis vel strigosis, sursum incurvo-adpressis; lamina foliorum orbicularis vel ovata, usque ad 24 cm. longa et 13 cm. lata, abrupte subacuta, basi rotundata, chartacea, integra vel undulata, recurvata, supra rugosa, glabra vel strigosa, pilis in costa et venis positis, venis (circa 5-paribus) et venulis valde et crasse reticulatis, profunde impressis, subtus pilosa, pilis cinereis, circa 2 mm. longis, patulis, curvatis, costa et venis prominentibus; folia novella utrinque dense fulvo-pilosa; petioli crassi, usque ad 3 cm. longi, plusminusve strigosi, saepe curvati; flores solitarii vel pauci, in calcaribus axillaribus compressis dispositi; pedicelli crassi, 3.5 cm. longi, dense tomentosi, pilis fulvis usque ad 5 mm.

longis; bracteae lanceolatae, 3.5–4 cm. longae, 1.5 cm. latae, leviter falcatae, dense tomentosae, pilis fulvis usque ad 5 mm. longis; calyx glaber vel parce pilosus; corolla 4.5 cm. longa, rubra, glabra, minute papillosa, tubo cylindrico, basi 7 mm. lato, usque ad 15 mm. supra basim 3.5 mm. lato, prope oram 6 mm. lato, lobis suborbicularibus, 4 mm. longis, 3 mm. latis, emarginatis; stamina inclusa, ad medium tubi corallae affixa, antheris sagittatis, 15 mm. longis, basi 2.5 mm. latis, apice acutis, lobis apice barbatis; stylus 3.5 cm. longus, glaber; stigma bilobatum, lobis aequalibus, cupuliformibus; ovarium glabrum.

In connection with his description of this new species, Leonard writes:

The leaf blades of Ducke's material are more ovate and less rounded at the base than are those of the type.

The type plant, Schultes informs us, is a rampant liana clambering over grasses or low shrubs. Only one plant was observed. The specific epithet is derived from λάσῐος, shaggy, and φυτον, plant, and alludes to the densely fulvous-tomentose inflorescence, young leaves, and stem tips.

This new species resembles and is probably closely related to *Mendoncia gigas* Lindau. The size and shape of the bracts and the nature of the pubescence covering them and the peduncles are much the same for the two species. The leaf blades, however, of *Mendoncia gigas* are generally smaller, not exceeding 13 cm. in length and 7 cm. in width, and no mention is made of the suborbicular type of leaf sometimes subtending the inflorescence. Again the calyx of Lindau's species is described as puberulous, whereas in *Mendoncia lasiophyta* it varies from glabrous to sparingly long-pilose. The corolla lobes of *Mendoncia gigas* are larger, 6 to 7 mm. in diameter instead of 4 mm. long and 3 mm. wide, and their tips are rounded instead of emarginate. Finally, the ovary, pronouncedly puberulous in *Mendoncia gigas*, is definitely glabrous in *M. lasiophyta*.

A photograph of *Ule 9800*, the type of *Mendoncia gigas*, is in the U.S. National Herbarium. The type was collected at Seringal Auristella, along the Río Acre in Perú.

Brazil: Estado do Amazonas, Esperança, at mouth of Rio Javarí, October 18, 1945, *A. Ducke 1851*.

Colombia: Comisaría del Amazonas, vicinity of Leticia, Río Ama-

zonas. November 1948, *Richard Evans Schultes & Francisco López 10400K* (TYPE in U.S. Nat. Herb.).

**Sanchezia thinophila** *Leonard sp. nov.*

Frutex, caulibus subquadrangularibus, hirtellis, pilis usque ad 1 mm. longis, patulis vel adscendentibus; lamina foliorum elongato-lanceolata, acuminata (apice ipso obtuso), basi angustata, in petiolum decurrens, subcoriacea, marginibus leviter crenatis, supra glabra, minute aspera, cystolithis obscuris, costa et venis lateralibus (15–20 paribus) utrinque prominentibus, subtus hirsuta, cum pilis brunneo-gilvis, patulis vel adscendentibus, rectis vel leviter curvatis, usque ad 1.5 mm. longis; petioli circa 2 cm. longi, canales glabri, subtus hirtelli; paniculae terminales, parce ramosae, 22 cm. longae, rhachi et pedunculo (5.5 cm. longo) hirtello; bracteae rubrae, ovatae vel lanceolatae (apice ipso obtuso) pari infimo 7 cm. longo, 4 cm. lato, aliis deinceps minoribus, glabris vel basi hirtellis, ciliatis, fasciculi multiflori (floribus 10 vel pluribus); bracteolae ovatae, maximae et infimae 3 cm. longae, 1.8 cm. latae, apice rotundatae, glabrae vel sursum hirtellae; calycis segmenta subligulata, usque ad 2.5 cm. longa, sursum 4–7 mm. lata, obtusa vel rotundata, basi angustata, glabra vel apice pubescentia, pilis circa 0.25 mm. longis; corolla 4 cm. longa, flava, deorsum glabra, sursum hirsuta, pilis retrorse adpressis, albis, circa 0.5 mm. longis, tubo cylindrico, basi 3 mm. lato, prope oram 7 mm. lato, lobis ovalibus, circa 3 mm. longis et latis, emarginatis; stamina circa 4 cm. longa, filamentis planis, parce pilosis cum pilis patulis, usque ad 2 mm. longis, antheris 6 mm. longis, 2.5 mm. latis, dorso glabro, ventre puberulo, calcaribus basalibus 0.75 mm. longis; ovarium glabrum; stigma bilobatum, lobis inaequalibus.

Leonard states further:

*Schultes 6937*, collected in the vicinity from whence the type of *Sanchezia thinophila* was taken, has the same general appearance, but

differs in being essentially glabrous. The specimen is very immature, the corollas being barely formed. Until mature collections are available, it cannot be determined definitely whether *Schultes 6937* is only a glabrous form of *Sanchezia thinophila* or a new species.

The type plant, Schultes states, was growing on a sandy beach at the mouth of the Río Loretoyacu, hence the specific epithet *thinophila* (θις [θινο-], beach, and φιλέω, loving).

COLOMBIA: Comisaría del Amazonas, bank of Loretoyacu River, 100 meters altitude. October 20–30, 1945, *Richard Evans Schultes 6607* (TYPE in U.S. Nat. Herb.).

## COMPOSITAE

**Gongylolepis maroana** *Badillo* in Bot. Soc. Venez. Ciénc. Nat. 8 (1943) 237.

Recently, a number of collections of this curious composite have been reported from eastern Colombia (Schultes in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 310, 14 (1949) 47). The two additional collections from the Comisaría del Vaupés indicate that *Gongylolepis maroana* is, indeed, one of the most widespread as well as dominant shrubs on the isolated quartzite areas in Amazonian Colombia.

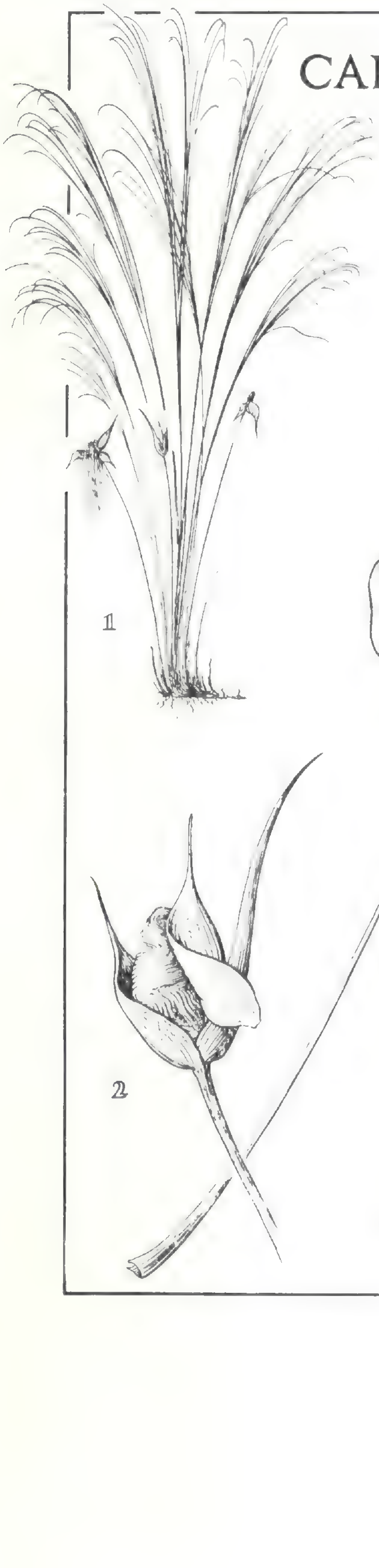
COLOMBIA: Comisaría del Vaupés, Macaya River, Mount Chiribiquete. "Bush". July 24, 1943, *Richard Evans Schultes 5742*.—Comisaría del Vaupés, Río Vaupés, Caño Pacú. Sandy savanna. "Bush; 15 feet." March 6, 1944, *Richard Evans Schultes 5816*.

## EXPLANATION OF THE ILLUSTRATION

PLATE VII. CARLUDOVICA AURANTIACA *R. E. Schultes*. 1, habit of plant, about one tenth natural size. 2, early stage of inflorescence, showing spadix with staminodes still wrapped in translucent spathes. One spathe is detached at base to show spadix and coiled mass of staminodes within. About one half natural size. 3, female flower from above; areas shaded with diagonal lines indicate scars left by the caducous staminodes. About ten times natural size. 4, male flower, lateral aspect. About ten times natural size. 5, spadix with young fruits. About three times natural size. 6, leaf, about one third natural size.

*Drawn by* ELMER W. SMITH

# CARLUDOVICA
## *aurantiaca*
R. E. Schultes




E. W. Smith

## EXPLANATION OF THE ILLUSTRATION

PLATE VIII. CARLUDOVICA AURANTIACA. A photograph of the colony from which the type collection was taken.

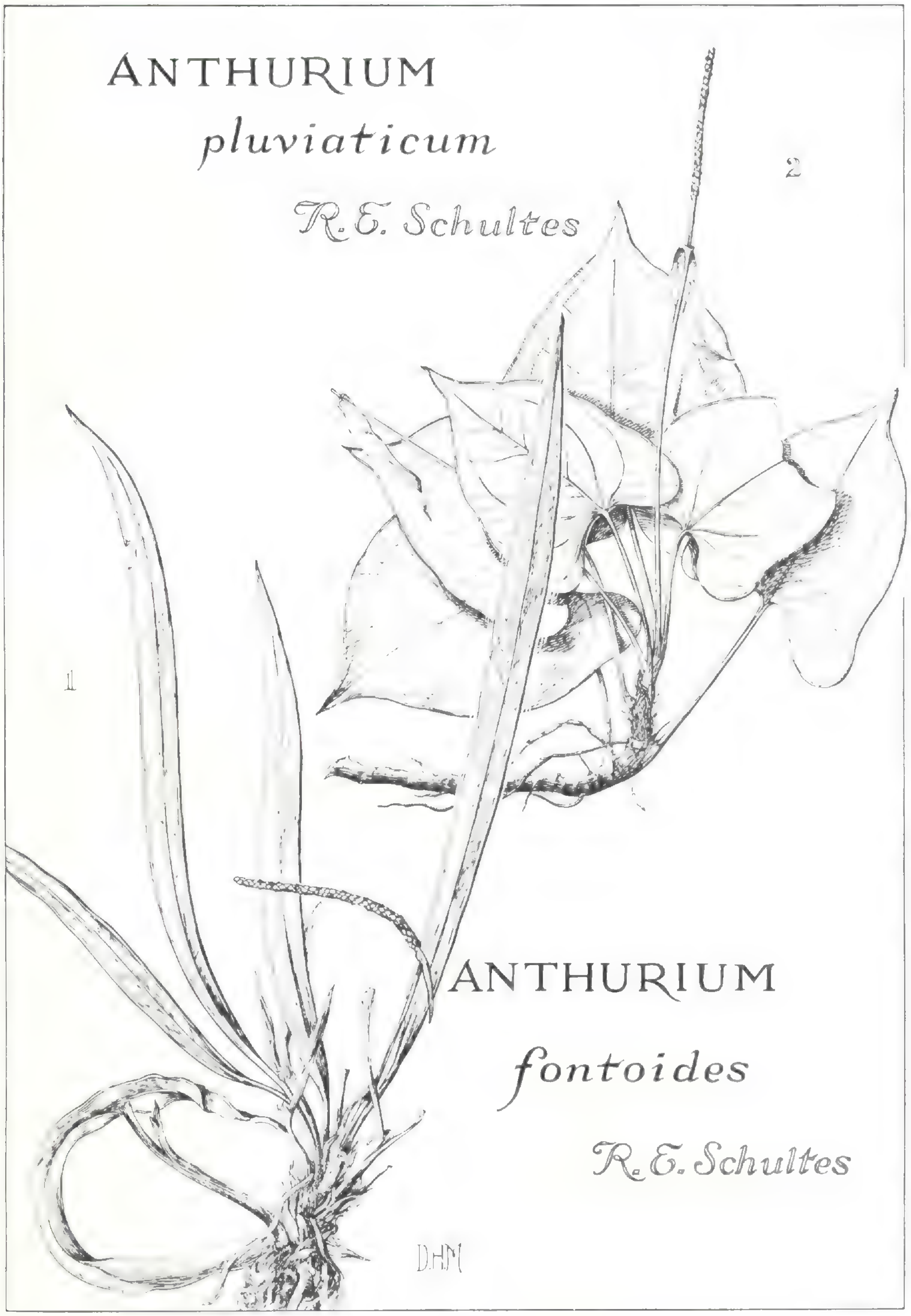
*Photograph by* RICHARD EVANS SCHULTES

# Plate VIII

## EXPLANATION OF THE ILLUSTRATION

PLATE IX. 1, ANTHURIUM FONTOIDES *R. E. Schultes.* 2, ANTHURIUM PLUVIATICUM *R. E. Schultes.* Habit drawing of plants, three eighths natural size.

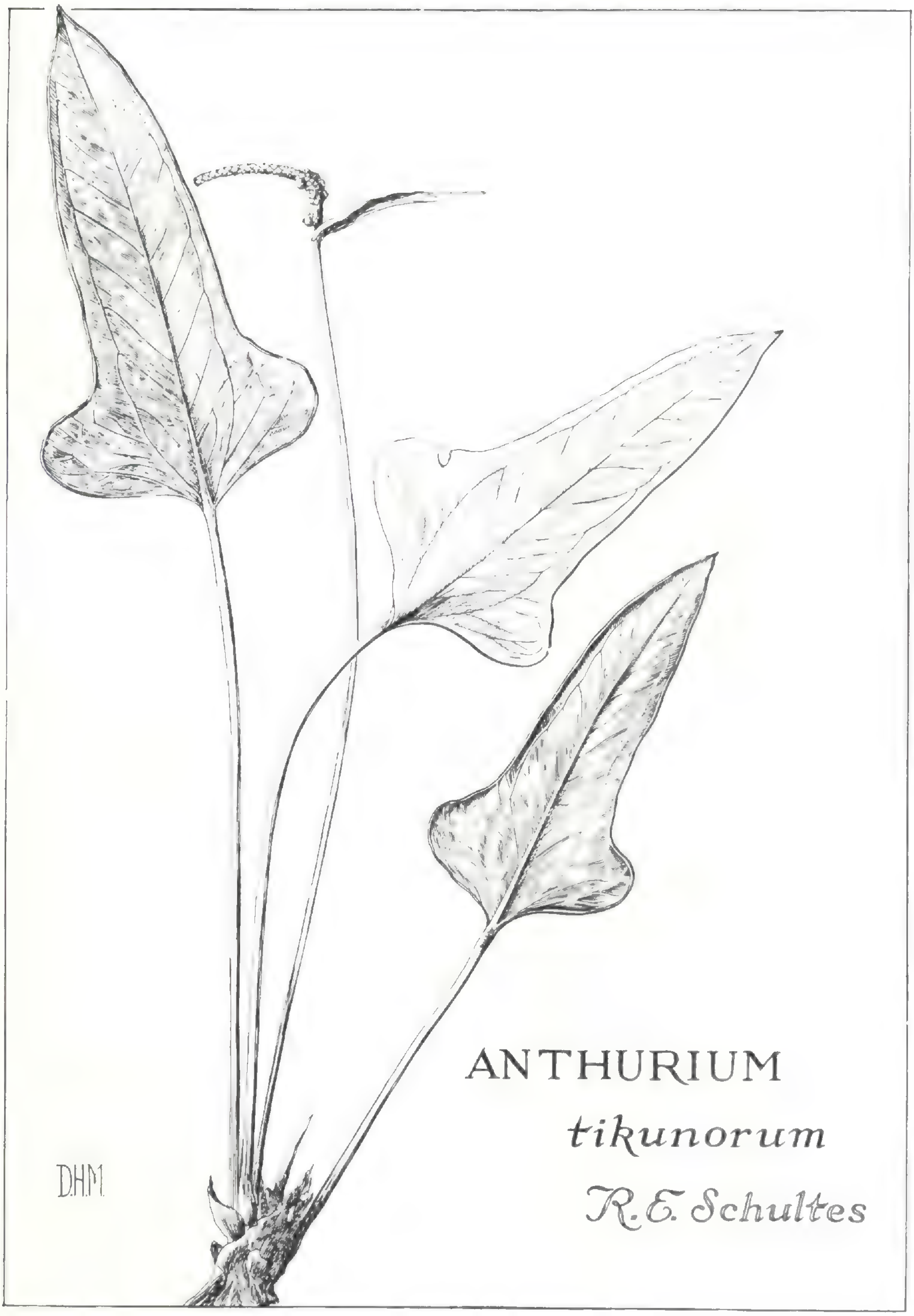
*Drawn by* DOROTHY H. MARSH


ANTHURIUM
pluviaticum
R.E. Schultes
2
1
ANTHURIUM
fontoides
R.E. Schultes
D.H.M

## EXPLANATION OF THE ILLUSTRATION

PLATE X. *ANTHURIUM TIKUNORUM R. E. Schultes.*
Habit drawing of plant, three eighths natural size.
*Drawn by* DOROTHY H. MARSH

PLATE X



ANTHURIUM

*tikunorum*

*R.E. Schultes*

D.H.M.

## EXPLANATION OF THE ILLUSTRATION

PLATE XI. PAEPALANTHUS FASCICULATUS (*Rottb.*) *Körn.* in sandy spot at La Chorrera, Rio Igaraparaná, Colombia.

*Photograph by* RICHARD EVANS SCHULTES

# Plate XI

## EXPLANATION OF THE ILLUSTRATION

PLATE XII. HERRANIA BREVILIGULATA *R. E. Schultes.* 1, leaf, about one third natural size. 2, flower, about one half natural size. 3, petal, twice natural size. 4, staminode and anthers, twice natural size. 5, ovary and style, four times natural size.

*Drawn by* ELMER W. SMITH

# HERRANIA
## *breviligulata*
### *R.E. Schultes*

*E.W. Smith*

## EXPLANATION OF THE ILLUSTRATION

PLATE XIII. HERRANIA PURPUREA (*Pittier*) *R. E. Schultes*. 1, leaf, about one third natural size. 2, flower, about one half natural size. 3, petal, twice natural size. 4, staminode and anthers, twice natural size. 5, fruit, one half natural size.

*Drawn by* ELMER W. SMITH

# HERRANIA *purpurea*

*(Pittier) R.E.Schultes*

## EXPLANATION OF THE ILLUSTRATION

PLATE XIV. COMBRETUM WANDURRAGANUM *R. E. Schultes*. Fruiting branch of the type plant.

*Photograph by* RICHARD EVANS SCHULTES

# Plate XIV

## EXPLANATION OF THE ILLUSTRATION

PLATE XV. MENDONCIA LASIOPHYTA *Leonard*. a, leaf blade, one half natural size. b, portion of leaf blade (upper surface), one half natural size. c, portion of leaf blade (upper surface enlarged to show stelliform cystoliths), three and one half times natural size. d, part of inflorescence, one half natural size. e, hair from bract, six times natural size. f, stamen, twice natural size. g, corolla lobe, twice natural size. h, calyx, one and one half times natural size. i, stigma, three times natural size. j, a cystolith shown in detail, about eleven times natural size.

Drawn from the type specimen *Schultes & López 10700K*.

# Plate XV

## EXPLANATION OF THE ILLUSTRATION

PLATE XVI. SANCHEZIA THINOPHILA *Leonard*. a, basal portion of inflorescence, one half natural size. b, bract, one half natural size. c, leaf, one half natural size. d, calyx, natural size. e, stigma, about three times natural size. f, corolla, natural size. g, anther (dorsal view), about twice natural size. h, anther, (ventral view), about twice natural size.

Drawn from the type specimen *Schultes 6607*.

# Plate XVI

# BOTANICAL MUSEUM LEAFLETS
## HARVARD UNIVERSITY

CAMBRIDGE, MASSACHUSETTS, JULY 6, 1953 VOL. 16, NO. 5


# NOTES ON THE CULTIVATED LULO


BY

RICHARD EVANS SCHULTES[1] AND JOSÉ CUATRECASAS[2]


ONE of the most delicious of those cultivated fruits peculiar to the northern Andes is the *lulo* or *naranjillo*. This fruit is very common from Perú and Ecuador to northern Colombia and Venezuela. Its area of greatest production centers probably in Ecuador and southern Colombia.

In spite of the fact that a number of articles on this economic fruit have recently appeared (Pérez-Arbeláez, "Plantas medicinales y venenosas de Colombia" (1937) 246; Chalons in Agric. Amer. 4 (1944) 110–112; McCann, ibid. 7 (1947) 146–149; Hodge in Rev. Fac. Nac. Agron. 7 (1947) 147–154; Hodge in Journ. N.Y. Bot. Gard. 48 (1947) 155–159; Pérez-Arbeláez, "Plantas útiles de Colombia" (1947) 451), little of a detailed nature has been known about the taxonomy of the source-plant. Although it has been generally accepted that the lulo represented *Solanum quitoense*, there is sufficient variation between the lulo plants from different parts of Colombia to raise some doubt that only one species is


[1] Botanist, Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Research Fellow, Botanical Museum of Harvard University.

[2] Curator of Colombian Botany, Chicago Natural History Museum.

involved (Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1949) 45, t. 10).

We have recently attempted to study the numerous specimens of lulo now available. Although many more field observations and much more material from a wider area are greatly to be desired, we believe that our studies have led to at least a preliminary clarification of the problem. It is merely as a preliminary contribution that we offer the following notes.

Both of us have seen the lulo under cultivation in the field. Our experience and field notes are in complete agreement with the results of our study of the available herbarium material.

We wish to thank the Directors of the following botanical institutions for their kindness in allowing us to consult the material entrusted to their care: Gray Herbarium, Arnold Arboretum, Economic Herbarium of Oakes Ames (Harvard University); Chicago Natural History Museum; National Arboretum Herbarium (Beltsville, Maryland); U. S. National Herbarium (Washington, D.C.); Royal Botanic Gardens (Kew); British Museum (Natural History) (London); Musée d'Histoire Naturelle (Paris); Jardin Botanique de l'Etat (Brussels); Jardin Botanique (Geneva); and the Jardín Botánico (Madrid).

The two concepts which are involved may be distinguished by the character in this key.

I. Planta perfecte inermis. Peruvia, Ecuadore, Colombia meridionali.

*Solanum quitoense*

II. Planta ramulis, petiolis, nervisque variabiliter armata, Colombia centrali et septentrionali.

*Solanum quitoense* var. *septentrionale*

**Solanum quitoense** *Lamarck* Illustr. 2 (1797) 16.

*Solanum angulatum* Ruiz & Pavón Fl. Peruv. 2 (1799) 36, t. 170, fig. a.

*Solanum quitense* Humboldt, Bonpland & Kunth Nov. Gen. et Sp. 3 (1818) 25.

COLOMBIA: No definite locality. 1842, *Sinclair s.n.*—Comisaría del Putumayo. Valley of Sibundoy, Sibundoy. Alt. about 2225–2300 m. February 16, 1942, *R. E. Schultes 3271.*—Same locality. "Large shrub. Stem and under surface of leaf purplish, hairy. Flowers white, anthers yellow. Fruit orange coloured and size of oranges. *Naranjillo.* Kamsá Indian name: *ma-sha-kve.*" May 29, 1946, *R. E. Schultes & M. Villarreal 7616.*

ECUADOR: No definite locality. "Nuqui." January 1848, *Seemann s.n.*—Guayaquil. [Cultivated from seed collected in Chimbo.] November 27, 1897, *J. V. S. Muller s.n.*—Vicinity of Huigra, "mostly on the Hacienda de Licay." August 1918, *J. N. Rose & G. Rose 22398.*—Garden in Otavalo. Alt. 8500 feet. February 20, 1921, *W. Popenoe 1266.*—Baños, Tungurahua. Alt. 6500 feet. March 6, 1921, *W. Popenoe 1267.*—Provincia de Tungurahua, Valley of Pastaza River. Between Baños and Cashurco. Alt. 1300–1800 m. September 25, 1923, *A. S. Hitchcock 21787.*—Provincia de Tungurahua, between Hacienda San Francisco and Río Margarjitas, alt. 1225 m. March 20, 1939, *C. W. Penland & R. H. Summers 168.*—Provincia de Pichincha, Valley of Río Saloya, Los Paysanes. Alt. 1400 m. June 28, 1939, *E. Asplund 7298.*—Provincia de Imbabura, above García Morena. "Common at edges of clearings. Alt. 4200 feet. Suffructescent herb, to 2 meters. Corollas whitish to pale magenta. *Naranjilla.*" August 9, 1944, *W. B. Drew E-531.*

PERU: "38. 786—Solanum. Planta culta in Hort. Oppido la Magdalena. Solanum." No collector, no date. [Possibly same collection as following.]—"Ex oppida La Magdalena in Peruvia. Habitat in Limae hortic. Floret. Jun. Julio, Anoto et Sept. Fructus valde odorus. Vulgo *Naranjas de Quito.* Naturales Limae exprimunt aliquot gutas huju fructu in potum (vulgo *maté*) protectorem sauvem. Vulgo *Naranjitas de Quito.*" August 1782, *H. Ruiz & Pavón s.n.*—"Lima Hort." 1778, *H. Ruiz & Pavón s.n.*—"Maynas," 1831. *Poeppig 2222.*—"Chacapoyas, Perú." No date. *Matthews s.n.*

COUNTRY UNKNOWN: "Ex hb. de Jussieu No. 6458."—"Ex hb. Lamark."—"Ex hb. De Candolle." [Apparently a Pavón specimen.]

**Solanum quitoense** *Lamarck* var. **septentrionale** *R. E. Schultes & J. Cuatrecasas var. nov.*

Haec varietas a *Solano quitoensi* principaliter ramis, petiolis foliorum superficiebus superioribus et inferioribus in nervis spinosis spinulosisque differt.

COLOMBIA: Departamento de Antioquia, no date, *Jervisse sn.*—Departamento del Tolima, Ibagué. 1844. *J. Goudot s.n.*—Departamento del Valle de Cauca, La Paila, April 1853, *Holton 23.*—Departamento Norte de Santander, near Ocaña. "Bush, open spaces. Alt. 8,500′. Shrub or small tree, 10–19′, slender growth stems with thorns; flowers whitish, calyx and leaf with long, dark violet velvet, latter 1½–2′ broad and 2½–3′ long; fruit yellow with prickles, plum-shaped, edible, sour." January 1878, *Kalbreyer 543.*—Departamento de Santa Marta, [Santa Marta mountain], alt. 6,000 ft. January 1903, *H. H. Smith* 1853.—Departamento de Cundinamarca, cercanías de San Bernardo hacia Sasaima, alt. 1600–1800 m. "Matotales y cafetales. Gran hierba de tallo grueso y aquifolioso; cálices algo violáceos, corola blanca o blanco-violácea." June 23, 1940, *J. Cuatrecasas 9604.*—Departamento de Antioquia, Itaquí, July 1944, *Br. Daniel 3352.*—Departamento de Antioquia, alrededores de Medellín, Río Negro, alt. 1,560 m. "*Lulo.* Cultivated," February 11, 1946, *W. H. Hodge 6712.*—Departamento del Valle, Cordillera Occidental, vertiente oriental, Quebrada del Tigre, Quebradita de Pultabrava, alt. 1,440 m. "Hierba muy robusta, 1 m. alt. Hoja blanda rigida, verde oscura haz, violeta envés. Hoja tierna violeta, ramos id. Cáliz violeta. Corola blanca o blanco violácea. Anteras amarillas. Fruto 5 cm. diámetro." October 28, 1946, *J. Cuatrecasas 22694.*—Departamento del Valle, Cordillera Occidental, vertiente occidental, hoya del Río Digua, Río San Juan, abajo de Queremal a la derecha del río entre km. 52 y 53, alt. 1,300–1,500 m. "Hierba robusta. Hoja muy blanda, envés y pecíolo violeta. Haz verde, oscuro. Cáliz violeta claro. Corola exteriormente violeta claro, interiormente blanca. Anteras amarillo claras. Fruto maduro amarillento, sabroso—5 cm. diám., hirsuto. *Lulo morado.*" March 19, 1947, *J. Cuatrecasas 23853.*—Departamento del Valle, Cordillera Occidental, vertiente occidental, hoya del Río Digua, lado derecho, entre Queremal y La Elsa, alt. 1,200–1,160 m. "Hierba robusta, 1 m. o más. Hoja verde oscura haz, verde clara envés. Pecíolo verde pálido (verdoso blanquecino). Cáliz verdoso blanquecino. Corola blanca con ligero tono lila. Anteras amarillas. Frutos amarillo-anaranjados (maduros), 4.5 cm. diám., cubiertos de pelusa patente y punzante. Pulpa acídula, muy sabrosa. *Lulo.*" March 27, 1947, *J. Cuatrecasas 23992.*—Departamento del Valle, Cordillera Occidental, vertiente occidental, hoya del Río Dígua, lado izquierdo, Piedra

de Moler. Bosques, 1050 m. alt. "Hierba muy robusta y ramificada. Hojas blanquecinas. Corola blanca. Anteras amarillas. Bayas 4 cm. diám., amarillo-anaranjadas, erizadas. *Lulo de perro.*" August 19–28, 1943, *J. Cuatrecasas 15031.*

Ecuador: "Ad radices M. Chimborazo, alt. 2,300′. Suffrutex 5-pedalis." June 1860, *R. Spruce s.n.*

Venezuela: Colonia Tovar, 1854–55, *A. Fendler 1001.*—Same locality and date, *A. Fendler 1002.*—Same locality and date, *W. Sondar s.n.*—Caracas, neighborhood of Guaranas. Alt. 3,000 ft. "Flowers blue, fruit without prickles, small, veined, tall shrubby plants." December 1854, *Birschel s.n.* (K).—"Habitat ad Orinocum, prope Carichana." No collector, no date [ex "hb. Bonpland"].

Our studies lead us to the conclusion that typical *Solanum quitoense* is confined to the southern part of the range of the species complex and occurs in Perú, Ecuador (where it appears to be most abundant) and southern Colombia. This concept is easily recognized because it is completely devoid of spines along the branches, petioles and veins. It is deeply significant, we feel, that all of the collections from this southern periphery, with one exception, have not the slightest trace of spines. In other respects (such as color and density of indumentum on the leaves) they are also rather homogeneous. The collection *Spruce s.n.*, from the base of Mt. Chimborazo, is the single exception; it has slight and very remote spines, and the Kew specimen is annotated as representing one of the types of Solanum, the fruit of which is gathered for food in Ecuador. It may well represent a distinct variant, but paucity of material precludes a more precise disposition.

Herbarium material from the northern periphery—most of Colombia and part of Venezuela—is, without a single exception, spiny. There is tremendous variation in the abundance and size of the spines which are borne along the branches, on the petioles and along the nerves of the upper and lower surface of the leaves. Some speci-

mens have very small and remotely placed spinules; the other extreme has stout spines up to 10 or 12 mm. in length. *Cuatrecasas 23992*, from the Río Dígua, is almost devoid of spines, whereas *Cuatrecasas 15031*, from the same area, is well armed on the petioles and leaves with spines up to more than 1 cm. in length. *Hodge 6712*, from Antioquia, has remote but strong spines along the petioles and the midrib and, occasionally, even on the tertiary veins. The collection *Cuatrecasas 9604*, from Cundinamarca, has stouter spines, even on the upper surface of the leaves. If we can judge from the admittedly limited material at hand, we may suggest that there is evident a perceptible increase in density and size of spines as one proceeds northwards. Some of the material from Cauca is only weakly armed; the stoutest armature is found on specimens from the central and northern Andes of Colombia and Venezuela. Collections from intermediate regions, such as *Cuatrecasas 22694*, from the Departamento del Valle, would seem to be links between *Solanum quitoense* and its var. *septentrionale*.

The recognized fact that the density and size of the spines vary so much does not, we feel, argue against the separation as a distinct variety of the spiny from the unarmed variants. The genus *Solanum* tends to be extremely variable in respect to spines *where they occur*. There is a very distinct possibility that, when ample material is available for study and when adequate field studies have been carried out, the variation in color and density of the soft indumentum of the leaves may also be found to be sufficiently important to use in the recognition of additional varieties. However, we cannot, at the present state of our knowledge, evaluate the characters which may reside in the differences of leaf pilosity in the *Solanum quitoense* complex.

We have chosen the varietal epithet *septentrionale* to

indicate our belief that the spiny material represents a northern variant of *Solanum quitoense*.

In the Mutis collection of water-colors of Colombian plants, executed between 1783 and 1808 and preserved in the Jardín Botánico in Madrid, the two concepts *Solanum quitoense* and *S. quitoense* var. *septentrionale* are clearly distinguishable. Plate 38 in volume 19 consists of two double-sized black and white sheets, one depicting a flowering branch with a floral dissection, one with a fruiting stem and a dissected fruit; this is the spineless *Solanum quitoense*. Plate 39, representing *Solanum quitoense* var. *septentrionale*, has one sheet showing, in colors, a leafy branch in flower and one piece of stem in fruit; the stems, petioles and veins on the under surface of the leaf are armed with heavy spines and the flowers are larger than those shown in plate 38.

There is a large colored plate of *Solanum quitoense* (C. M. Curtis del.) in the De Candolle herbarium in Geneva. It is annotated as follows: "*Solanum angulatum*. Imported from Peru in 1824, by Robert Barclay. Bury Hill"; and in De Candolle's hand: "Gravure donnée par M. Barclay. Ne fait partie d'aucun ouvrage. A.DC. 1839."

The most extensive field notes found on an herbarium collection are preserved on the specimen of *J. V. Sigvald Muller s.n.* at Kew. Because of their completeness, we hereby publish them almost in full:

> . . . the plant is, as you no doubt know, a climber, the fruit bright orange, nearly round or spheroid, about $1\frac{3}{4}$ inch to 2 inches in diameter. The pulp is bright green, very juicy and very aromatic. The seeds are mixed with the pulp when ripe . . . . The seeds are fixed to a softer body, than what I describe as solid white, but this solid part gets broken up in the pulp (and is eaten as well) when the pulp is squeezed out. The pulp looks like the pulp from green gooseberries; it is eaten with a little sugar. Is exceedingly pleasant and cooling. With cream it must be a delicious dish. The sugar is mixed with the pulp to taste. The pulp alone is not more acid than to make it pleas-

## EXPLANATION OF THE ILLUSTRATION

PLATE XVII. Flower and young fruit of the type plant of *Solanum quitoense* var. *septentrionale*.

*Photograph by* J. CUATRECASAS

# Plate XVII

ant, even without sugar, which is a costly luxury in the Andean Valley. Large quantities come down to Guayaquil where they are rather expensive, as the mule transport over the Cordilleras is long and tends towards ruining the delicate fruit. Of late the pulp, strained from the seeds and added to water, is used for ice-making. The flavour is excellent and was quite new to me. Hence, I went into the market, and went into the question what fruit it was. I was told by the English people, that it was a guava (there are many varieties here), but that could not be.

Ruiz, who encountered *Solanum quitoense* in Perú in 1777, wrote of it (under the synonym *S. angulosum*) "....Narangitas de Quito, por haber sido transplantado de esta Provincia, y tener sus frutos la figura y color de una Naranja pequeña; las mugeres estiman estos frutos por su olorcillo y por el gusto particular que dá á la bebida del Mate, en la que acostumbran echar algunas gotas de su xugo; tambien los ponen entre las mixturas de flores para que hermosée y contribuya con su olor á hacer mas grata la mixtura" (Ruiz, H.: "Relación histórica del viage a los Reynos del Perú y Chile" Jaramillo-Aranjo ed. (1952) 30).

# PLANTAE COLOMBIANAE XIV

## RHYTIDANTHERAE MONTIS MACARENAE NOVA SPECIES

BY

RICHARD EVANS SCHULTES[1]

RECENT collections of plants from the northern part of the Cordillera de La Macarena in the Intendencia del Meta, Colombia, have been replete with extraordinary novelties and endemics. One of the most outstanding of these plants is a hitherto undescribed species of the ochnaceous genus *Rhytidanthera*. Because of its unusual size and beauty, it may be named

**Rhytidanthera regalis** *R. E. Schultes sp. nov.*

Arbor magna usque ad septuaginta pedes alta, frondosissima, aspectu nobilis. Truncus columnaris, basi saepissime aliquid arcuatus, usque ad duo pedes in diametro, rufo-brunneo cum cortice subruguloso et minute lenticellato; ligno duro, albido. Folia imparipinnata, conspicue pendula; petioli 20–30 cm. longi, basi usque ad 2 mm. in diametro; foliola plerumque tredecim (cum petiolis 4–6 mm. longis), lateralia alterna, 3–4.5 cm. distantia, lanceolata, apice acuto-acuminata, basi late cuneata vel subrotundata, 15–22 cm. longa, 3–5.5 cm. lata; foliolum terminale liberum, perfecte lanceolatum, apice

[1] Botanist, Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Research Fellow, Botanical Museum of Harvard University.

sensim acuminatum, basi cuneatum, usque ad 15.5 cm. longum, 3–3.5 cm. latum; alia marginem versus vix retrocurvata, margine grossiuscule serrata, dentibus apice paulo incurvis et plerumque 5–8 mm. distantibus, supra nitida venis non elevatis, subtus pallidiora, venis prominenter elevatis, secundariis plusminusve viginti quinque ad triginta; stipulis caducis. Inflorescentiae terminales, longae, quam folia paulo breviores, usque ad 20 cm. longae, rhachide 2–3 mm. in diametro, pauciflorae (floribus usque ad viginti); rhachide rami usque ad 10 cm. longi; pedicelli ad rhachidem articulati, robustiores lignosique, usque ad 10–12 mm. longi, apice subclavati, basi 1.5 et apice 2.5 mm. in diametro. Flores solitarii, aromatico-fragrantes, mucilaginosi, alabastris comparate parvis, usque ad 15 mm. longis, 6 mm. in diametro. Sepala quinque, imbricata, concava; duo exteriora subcoriacea sed marginem versus aliquid membranacea, late rotundata, margine subintegra, apice retuso-incisa, supra minutissime pulverulento-substriolata (non strigillosa), plusminusve 7 mm. longa, 12 mm. lata, basi cum plusminusve quattuor ad sex glandulis minutis digitaliformibus, usque ad 1.5 mm. longis, 0.25 mm. in diametro; interiora majora, membranacea vel apicem versus aliquid papyracea, concava, rotundata vel late oblonga, apice rotundata, margine irregulariter sublacerata, 11 mm. longa, 15 mm. lata. Petala quinque, alba, membranacea, leviter inaequalia, oblonga (30 mm.×15 mm.) vel oblongo-spathulata (30 mm.×apice 10 mm.) apice leviter fissa, margine integra. Stamina viginti octo ad triginti duo, brunneo-flava, subaequalia, usque ad 12 mm. longa. Antherae 10 mm. longae, 0.8 mm. latae, longitudinaliter rugulosae, filamentis 2 mm. longis, basi 0.7 mm. latis. Ovarium crassum, nigrum, inverse claviforme, apicem versus in stylum indeterminatum, erectum, luteum, paulatim attenuatum, usque ad 15 mm. longum, 2.5

## EXPLANATION OF THE ILLUSTRATION

PLATE XVIII. RHYTIDANTHERA REGALIS *R. E. Schultes.* Characteristic habitat on steep slopes or edges of cliffs. Macizo Renjifo, northwestern part of the Cordillera de La Macarena.

*Photograph by* R. E. SCHULTES

# Plate XVIII

mm. in diametro, quinque cum stigmatibus sessilibus. Capsulae usque ad 3.5–4 cm. longae, 0.5 cm. in diametro, apicem versus anguste falcatae.

Largest of the five known species of this endemic Colombian genus, *Rhytidanthera regalis* appears to be somewhat intermediate between *R. splendida* and *R. magnifica.* In addition to marked differences in the leaves, *Rhytidanthera regalis* can be distinguished from all other species in the important character of the number of stamens. *Rhytidanthera splendida* has 18–20 stamens; *R. magnifica* 40–50; *R. sulcata,* about 50; *R. mellifera,* 64; whereas *R. regalis* has 28–32. The fruit of *Rhytidanthera regalis* resembles in its size that of *R. sulcata,* but the latter is a small shrub; the margin of its leaflets is doubly serrate and its inflorescences are longer than the leaves. From *Rhytidanthera mellifera,* the new species differs strikingly in shape, size, and consistency of the leaves and in several important floral characters. Worthy of note is the presence in *Rhytidanthera regalis* (sometimes on the same flower) of both obovate-spatulate and oblong-rotund petals, although the great majority are oblong-rotund; this is, apparently, an unusual condition, for Dwyer (in Lloydia 9 (1946) 51) employs the difference in petal shape as the major character in his key to the species.

*Rhytidanthera regalis* is the second surprise which this genus—the only compound-leaved one in the *Ochnaceae* —has given us in the last decade. For one hundred years, *Rhytidanthera* has been known, although until 1904 it was not recognized as distinct from *Godoya.* In this century, only three species, all from Colombia (Santander, Magdalena and Boyacá), were collected (cf. Dwyer loc. cit. 50–54). This genus, native to the northern parts of the eastern Cordillera of Colombia, constituted then an extremely restricted endemic.

In 1943, *Rhytidanthera mellifera* was discovered on ancient (Cretaceous) sandstone hills in the Amazonian drainage of Colombia—a significant range extension. Although still confined within the boundaries of Colombia, *Rhytidanthera* had been located in the great Amazonian area, astonishingly distant from the eastern Cordillera. Furthermore, since the isolated sandstone hills of the Vaupés and Caquetá (where *Rhytidanthera mellifera* was collected) are remnant outliers of a once more or less continuous land-mass the core of which lies in southern Venezuela and British Guiana, the possibility of the discovery in the future of *Rhytidanthera* far to the east was open to suggestion. This curious distribution of *Rhytidanthera* was accepted (Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1949) 34) as evidence for believing in an ancient migration or flow of Andean elements eastward over the old Venezuelan-Guianan land-mass.

The collection in the Macarena Mountains of *Rhytidanthera regalis* stands out as one of the most significant phytogeographical discoveries of the last two decades. Both morphologically and geographically intermediate between the western species and the Amazonian *Rhytidanthera mellifera*, the Macarena species provides us with an unexcelled "missing link."

COLOMBIA: Intendencia del Meta, Cordillera La Macarena (extremo nordeste), Macizo Renjifo, faldas orientales. Alt. 600–1300 m. "Tree 60 ft. tall. Crown heavy. Flowers white, anthers yellow." December 30, 1950–January 5, 1951. *Jesús M. Idrobo & Richard Evans Schultes 871* (TYPE in Herb. Gray; DUPLICATE TYPE in Herb. Nac. Colomb.).—Intendencia del Meta, Sierra de La Macarena, Central Mountains, North Ridge. Alt. 1500 m. "Dense forest. Tree up to 15 m. high. Petals white ephemeral, stamens yellow, inclined to lower side of flower." December 30, 1949, *W. R. Philipson & J. M. Idrobo 2011.*—Intendencia del Meta, Cordillera La Macarena (extremo nordeste), Macizo Renjifo, faldas orientales. Alt. 600–1300 m. "Tree growing on steep, rocky slopes. Height 60–70 feet. Diameter at base 20 inches. Bark dark reddish brown, slightly rough. Wood very hard. Usually somewhat gnarled. Fruit green." December 30,

1950–January 5, 1951, *Jesús M. Idrobo & Richard Evans Schultes 852.* —Same locality and date. "Tree 50 ft. tall, very extensive crown. Branches gnarled. Fruits green." *Jesús M. Idrobo & Richard Evans Schultes 860.*—Same locality and date. "Flowers white. Tree 65 feet tall." *Jesús M. Idrobo & Richard Evans Schultes 869.*—Same locality. "Al borde de un peñasco. Árbol de 20 m., tortuoso. Tronco de 2 pies de diámetro. Flores blancas." January 22, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1188.*—Intendencia del Meta, Cordillera La Macarena, Mesa del Río Sansa. Alt. ca. 1000–1300 m. "Tree about 50 ft. tall, inclined over cliff." January 23, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1300.*

# A NEW SAURAUIA FROM MEXICO

BY
RICHARD EVANS SCHULTES

**Saurauia Comitis-Rossei** *R. E. Schultes sp. nov.*

Arbor robusta ut videtur. Rami scabrido-hirsuti sed denique subglabrescentes, fulvo cum cortice. Foliorum lamina petiolata, valde coriacea, obovata, apice acuta, basi rotundata, minutissime serrulata, supra atroviridis et muriculata et sparsissime setoso-pilosa, infra velutina et densissime pilosa albo-canis cum pilis atque cum pilorum floccis in nervorum axillis, nervis plusminusve tres et viginti parallelis, 15–18 cm. longa, 5.5–6 cm. lata. Inflorescentia comparate pauciflora, foliis brevior, cum pedunculo 10–15 cm. longa; pedunculus dense adpresso-hirsutus vel setoso-pilosus; pedicelli robusti, hirsuto-pilosiusculi, 4 mm. longi; bracteae conspicuae, lineares, setoso-pilosae, usque ad 1 cm. longae. Flores 1.8 cm. in diametro, albi. Sepala quinque, in maturitate sicca atque persistentia, obovata vel subrotundata, 6 mm. longa, 4 mm. lata, extus scabridule et minute setoso-pilosiuscula, margine minutissime ciliata. Petala quinque, fere usque ad basim libera, glabra, membranacea, late et subquadrangulateque rotundato-ovata, 8 mm. longa, 5 mm. lata. Stamina plusminusve viginti, corollae basi adhaerentia, basi setoso-barbata. Staminum filamenta 3–4 mm. longa; antherae versatiles. Ovarium globosum, quinque-partitum, glabrum, quinque cum stylis carnosis minutisque.

Fructus niger, 3 mm. longus, baccatus, quinque-carpellatus.

*Saurauia Comitis-Rossei* appears to have no close allies among the known species of Mexico and adjacent parts of Middle America. It is easily distinguished by its extremely thick and coriaceous leaves, as well as by a number of less conspicuous vegetative and floral characters.

The common name of *Saurauia Comitis-Rossei* is reported by Reko to be "mameyito." In southern Mexico, this name refers to a number of species of *Saurauia* and other genera with small, edible fruits.

At the request of the collector, I have named *Saurauia Comitis-Rossei* in honor of the Earl of Rosse in recognition of his active and enthusiastic interest in Mexican horticulture.

MEXICO: Estado de Oaxaca, Distrito de Juquila, Pochutla, Cafetal de San Antonio, 1700 meters altitude, February 1941, *B. P. Reko 6183* (TYPE in Herb. Gray).

## EXPLANATION OF THE ILLUSTRATION

PLATE XIX. SAURAUIA COMITIS-ROSSEI *R. E. Schultes*. 1, plant, one half natural size. 2, flower, twice natural size. 3, petal, three times natural size. 4, sepal, three times natural size. 5, sepal, inside view, three times natural size. 6, sepal, outside view, three times natural size.

*Drawn by* GORDON W. DILLON

PLATE XIX

# SAURAUIA

*Comitis-Rossei*

*R. E. Schultes*

# BOTANICAL MUSEUM LEAFLETS
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# THE PRE-COLUMBIAN CULTIVATED PLANTS OF MEXICO


BY

ROBERT L. DRESSLER


## INTRODUCTION

IN recent years many important papers have been published dealing with cultivated plants, their origins and their relationships to human cultures. These studies have served to increase greatly our knowledge and understanding both of the plants and of the people by whom they were used, as well as to point out some of the areas where further research is most urgently needed. Middle America, especially from central Mexico to Guatemala, was one of the two great centers of agriculture in the New World, the other being the Andean area, and a very considerable variety of cultivated plants were known to the peoples of this region. It seems, therefore, worthwhile to attempt an enumeration of the plants which were cultivated in this area, with a discussion of the pertinent botanical literature as to their origins, distributions and importance.


At this point the author wishes to acknowledge his indebtedness to the persons who have aided in this study by their discussion and suggestions concerning many phases of the problem. Special thanks are due Drs. Edgar Anderson, Howard S. Gentry, Gordon W.

Hewes, Albert F. Hill and Paul C. Mangelsdorf and Mrs. Margaret A. Towle.

In the understanding of any biological entity, it is first necessary to recognize and to characterize the elements of the group in question. When this is accomplished, one is able to investigate profitably the distribution, history and relationships of the form or group of forms. Unfortunately, the cultivated plants present the botanist with problems the complexity of which is rarely equaled among other organisms. By becoming associated with man the plants are partially freed from the restrictions of natural selection and carried to new areas where they may hybridize with related types from which they would otherwise be isolated. Man, in addition, aids in the development of new types by conscious and unconscious selection. All this leads to an inordinate degree of variability in such populations, an understanding of which can rarely be achieved by any one limited field of approach. However, with careful and discerning morphological study and the application of cytology and genetics, the newer tools of taxonomy, and with the cooperation of the ethnologist and the archaeologist it is possible to obtain results of very great value to all concerned.

The plants and animals domesticated by man have certain unique qualities which cause them to be of interest to the anthropologist. These center about the fact that they, themselves, are organisms, biological entities which may be studied as such, as well as in their relationships to man. In other words, though shaped by their association with man, they do not so nearly represent mere products of the human mind as do many other phases of human culture which we study.

Aside from the very basic importance of cultivated plants to all advanced cultures, there are more practical

reasons for studying them. Since these plants are basic to our present cultures as well, a more complete understanding of them allows us knowingly to reshape and improve our sources of food and raw materials in a way which was not possible for our ancestors.

In the present paper particular attention will be given to the geographic origins of the plants of this area. A number of different criteria have been used in attempts to determine the centers of origin of the plants which are more widely distributed in cultivation. These criteria have largely been developed and elaborated by de Candolle (35) and Vavilov (205, 206, 207); among the more important ones may be listed the following:

1. Distribution of the same species or its apparent ancestor in a wild state. This is a point of great importance, if one can be certain that the "wild" plants are not naturalized from cultivation. This, however, is not easy, particularly considering the grave doubts which exist as to the occurrence of "primeval forest" in much of tropical America. If, of course, a useful wild plant occurs over a wide area, then it is not only possible but quite probable that it will have been cultivated independently or simultaneously in two or more areas. The avocado (*Persea americana*) may be an example of this.

2. Distribution of primitive forms within the cultivated species. This, too, is of great value, if properly interpreted. The primitive forms of a group may, however, occur either in the center of origin or on the periphery of the plant's range. Each case must be decided on its own merits.

3. Center of diversity. This valuable concept, developed principally by Vavilov (205, 206, 207), is based on the idea that the greatest diversity within a species will occur in the area where it has been in cultivation for the longest time. Also, the area where varieties of the wild

parent species occur will be the area in which the greatest hybridization might be expected. While this concept is of great interest, both to the botanist and to the plant breeder, it must be realized that secondary centers of diversity may occur, through other factors such as hybridization or topography.

4. Distribution of closely related species. Within broad limits, this criterion is quite useful. Some of the squashes (*Cucurbita*), for example, have been thought to be natives of Asia, but there are no wild species of the genus in Asia, whereas there are many in America. In studying the relationships of species, cytogenetics may at times give evidence which is of great value, as will be shown to be the case with tobacco (*Nicotiana*).

5. Archaeological evidence. If sufficiently extensive, the record of archaeology may be of very great value. With the interest in carbon 14 dating, which is possible wherever there remains much organic matter, and increased attention to plant materials, this approach will become of increasing importance. Paleobotanical evidence, which is scanty for the cultivated plants, may conveniently be included in this category.

6. Historical data. Written accounts may often be of value in interpreting recent dispersals of cultivated plants, and there remains to be done a good deal of careful work along these lines.

7. Linguistic. The interpretation of routes of dispersal through the study of plant names is of interest and of some value, but this is probably the least reliable type of evidence and must be used with great caution.

As in other such cases, the most dependable studies are those that use all available data, from every source or aspect of the problem.

One of the untouched fields in ethnobotany is the study of the development and diffusion of geographical races

within a crop plant and of their relations with culture complexes. Such races have been studied in some degree for two Middle American crop plants, maize and cotton (104, 213). In each case it has been pointed out that the development of these races must have occurred in partial isolation and must have been related to cultural centers. It is for this reason especially desirable that extensive collections, if not studies, of truly native crop plants should be made before they are further decimated by the impact of modern cultural changes.

For the present paper, material has been drawn from the literatures of botany, ethnology and archaeology, but no pretense is made of a complete coverage of any one. A better representation of the historical writings of the earlier Spanish explorers would be especially desirable, but it is a subject worthy of study in itself. Several of the important references in this field are cited, but none has received the time and attention which it deserves. Some cultivated species may have been overlooked. It is hoped, however, that most of the important cultivated plants have been included, particularly those which have changed in their biological nature and their distribution through their association with man. One cannot, in a paper of this scope, list all the useful wild plants of Mexico, though the more important of these were doubtless planted at times by the early Mexicans; information is meager or lacking for those which have been intentionally omitted. The evaluation of the published information has in some cases been aided by frequent reference to herbarium material and by some field experience. It should be borne in mind that the peoples of this region had developed both agriculture and horticulture to a rather high degree and actually possessed botanical gardens which were, at the time, unrivaled among the European peoples.

## List of Species

The species are listed alphabetically, using the correct scientific names. Other names which have achieved a wide usage in the literature are in some cases cited in parentheses; these may be synonyms or names properly belonging to other species. No attempt has been made to list all of the common names; these may be sought in various works listed in the bibliography, particularly those by Standley and by some of the Mexican authors. For the sake of brevity, the number system of citation is used; and, for the convenience of the reader, the more recent or more comprehensive studies are indicated by an asterisk in the citations which follow the discussion of each species or group.

*Achras:* see *Manilkara.*

**Agave:** *Metl, maguey, henequén.*

The species of *Agave* are, to the present day, of great importance in Mexico as sources of food, drink and fiber. Among the Aztecs they entered directly and indirectly into religion, and it has been suggested (132) that the name, Mexico, may be derived from the Náhuatl word *metl*, which is a generic term for agaves and other plants of similar appearance. Among the species anciently grown in central Mexico for aguamiel and pulque are *A. atrovirens* Karw., which is the most important species, with many variations recognized by the growers, *A. latissima* Jacobi and *A. mapisaga* Trel. The types now used as a source of distilled beverages, such as *A. tequilana* Weber, were no doubt used in pre-Columbian times at least for food, but may not have been cultivated. Since both the cultivation and the uses of the pulque agaves center in central Mexico, where the species used seem to be native, these cultivated plants may be considered as having originated in that region.

*A. sisalana* Perrine and *A. fourcroydes* Lem. are both extensively cultivated as fiber plants and are apparently natives of the Yucatan Peninsula, where they were probably cultivated on a smaller scale in ancient times. Many wild species of *Agave*, and of *Fourcroya*, *Yucca* and *Bromelia* as well, may be utilized as fiber sources. Even in the wild state the agaves are not too well understood, because, like the cacti, their habit is so poorly suited to the preparation of specimens. Extensive field work is necessary to study such a group properly. (43, 132*, 156, 164*, 191*, 192)

**Amaranthus leucocarpus** *S. Wats.*, **A. cruentus** *L.*: *Huauhtli, bledos, alegría*, amaranth.

The great importance of these plants as "cereals" in ancient Mexico is clearly indicated by the tribute lists for the empire of Moctezuma (178), which indicate an annual levy of about 200,000 bushels of "huauhtli" or amaranth seed, as compared to about 280,000 bushels of maize and 230,000 bushels of beans. The grain amaranths have been poorly understood, but a recent careful ethnobotanical study by Sauer (178) has gone far to improve the situation. *A. leucocarpus* is still grown over a wide area in Mexico and Guatemala. *A. cruentus* occurs in the same area, but less extensively, and appears to be more important in Guatemala than *A. leucocarpus*. The great decline in cultivation of this useful plant in post-Columbian times is due, at least in part, to its suppression by the Spaniards because of its important role in Mexican religious ceremonies.

The grain amaranths are, by their botanical relationships, undoubtedly of American origin. Sauer suggests that *A. leucocarpus* may be most closely allied to *A. hybridus* L. and *A. Powellii* S. Wats., both of Mexico and Central America, while *A. cruentus* seems most

closely allied to the Central American *A. dubius* Mart. The exact origins are not certain, but Sauer and some other writers, have suggested that the cultivation of the grain amaranths may have preceded maize culture. There is not yet adequate archaeological evidence on this point. (5*, 17, 18, 102*, 132*, 143, 171, 178*)

**Anacardium occidentale** *L.*: *Marañón*, cashew. The cashew is thought by some (192) to occur naturally in southern Yucatan and may possibly have been cultivated there. It has the appearance of being native from Brazil to the Antilles, especially as a strand plant. (153, 191, 192)

**Ananas comosus** (*L.*) *Merrill*: *Piña*, pineapple. The pineapple is known to have been cultivated in Mexico before European contact (52). Since it is usually propagated by vegetative means, it must have been easy for the early Americans to select and grow seedless forms. The wild species of *Ananas* are all native to the Brazil-Paraguay region, though *A. comosus* sometimes occurs as an escape from cultivation in many parts of the world (15). Though the exact ancestry of the cultivated pineapple is not known, it is almost certainly a native of South America, probably of the south Brazil-Paraguay region. (15*, 52*, 53, 54*, 149, 186*, 196, 208)

Species of the related genus *Bromelia* are sometimes planted as hedges (149) and may have been so used in pre-Columbian times. These spiny plants produce an edible, acid fruit.

## Annona

The species of this genus are widely cultivated, but their histories are quite imperfectly known. The first accounts (93) indicate that several kinds were known at an early date in Mexico. There is little agreement

among authors as to their origins. Among the species which have been cited as cultivated in Mexico are the following:

**A. Cherimolia** *Mill.: Quauhtzápotl, chirimoya*, cherimoya.

The cherimoya is probably the best known and surely one of the best liked of the annonas. The evidence as to its origin and early distribution appears to be conflicting, doubtless due, in part, to confusion between the different species of *Annona*. Popenoe describes what he believes to be groves of wild cherimoyas in the mountains of Ecuador (151). Safford (170) and Costantin and Bois (55) present archaeological evidence of its early occurrence in Peru. Cobo (50) writes of introducing the cherimoya from Guatemala into Peru about 1630 and implies that it was unknown in Peru previous to that date. The name cherimoya is said to be of Quechua origin. Fries, in his monograph of *Annona* (80), does not comment as to the origin of *A. Cherimolia*.

**A. diversifolia** *Safford: Ilama.*

This species, though said to be of good quality, is not well known. It ranges from Colima and Guerrero into Central America. Safford (168) thinks it to be one of the types described by Hernández.

**A. glabra** *L.*

Reports as to the quality and cultivation of this species do not agree. It appears to have a very wide natural distribution as a strand plant.

**A. muricata** *L.: Guanábana.*

The origin of this widely distributed species is quite uncertain.

**A. purpurea** *Moc. & Sessé*

This species now ranges from Mexico to northern South America.

**A. reticulata** *L.*: *Anona.*

While Popenoe (153) and Standley (191) think that this is probably native in parts of Mexico and Central America, Fries (80) considers it to be West Indian.

**A. squamosa** *L.*: *Ahate.*

Fries (80) considers this species to be probably West Indian, because this section of the genus (*Atta*) has the greatest number of its species there. The section is not, however, limited to that area. This appears to be the tree which Hernández describes as native to the Pánuco region (northern Veracruz) and then introduced into Cuernavaca (93, 199). (55, 78*, 80*, 93, 150, 151, 153, 191, 196, 199)

**Arachis hypogaea** *L.*: *Tlalcacáuatl, cacahuate, maní,* peanut.

The peanut was apparently not of great importance in early Mexico, and it may actually have been introduced from the West Indies by the Spaniards as implied by Hernández (93). The compound name, "*tlalcacáuatl,*" or earth cacao, has been cited as evidence of its late arrival in Mexico (23, 129). In any case, all evidences point to a South American origin for this plant. Closely related wild forms are known from the south Brazil-Paraguay region. (5, 23, 32*, 47, 103*, 209)

**Bixa Orellana** *L.*: *Achiotl, achiote.*

This variable tree is grown for the pulp surrounding the seeds, which is used as a dye, food coloring, flavoring material and cosmetic. It is now known throughout tropical America. No careful study of *Bixa* is available, but it may possibly be of Amazonian origin. Other species which may be distinct have been described from that area. (49, 71, 93*, 133, 191, 207)

**Bomarea edulis** (*Tuss.*) *Herb.: Coyolxóchitl.*

This is probably the species of *Bomarea* which the Mexicans cultivated for the edible, tuberous roots and as an ornamental (93, 201). *B. edulis* is apparently a variable species with a wide natural range in Mexico and Central and South America. The Mexican members of this largely South American genus are not well understood. (14, 93, 162, 201*)

*Bromelia:* see under *Ananas.*

**Brosimum Alicastrum** *Swartz: Ox, ramón.*

Lundell (113) believes this to have been an important tree cultivated by the Mayas. The pulp of the fruit is sweet and edible, and the seed is eaten boiled or roasted or may be dried and ground into a flour. It is said to be quite palatable and nutritious. The ramón, now important as a source of forage, is abundant about ruins in Yucatan, implying former cultivation. The species is widespread and probably native from northwestern Mexico into Central America. (113*, 191*, 192)

**Byrsonima crassifolia** (*L.*) *DC.: Nantzinxócotl, nance, nanche.*

This shrub or small tree is of great importance in some areas. It appears to be the most important fruit of southern Veracruz and the Yucatan Peninsula during the summer months. The fruit, about the size of a large cherry, has a strange and at first unpleasant flavor, but is universally popular. The species appears to be native in savanna areas in Veracruz and Campeche and probably elsewhere. When natural groves occur near homes or villages, they are preserved and the fruit gathered for market and home consumption. (17, 133, 177, 191, 194)

**Calocarpum mammosum** (*L.*) *Pierre* (*Pouteria mammosa* (L.) Cronquist): *Tezonzápotl, sapote, mamey sapote, mamey colorado.*

The *mamey sapote* is a widely cultivated fruit tree which occurs from Mexico to northern South America and in the West Indies. Standley (191) and Popenoe (153) consider it as probably native to southern Mexico and Central America. (64*, 133, 153, 191*, 199)

**Calocarpum viride** *Pitt.* (*Pouteria viridis* (Pitt.) Cronquist): *Injerto*, green sapote.

This species, variable, though generally smaller-fruited than the last, ranges from southern Mexico to Costa Rica, but is apparently most frequently cultivated in Central America. (64*, 153*)

**Canavalia ensiformis** (*L.*) *DC.*: Jack bean.

This bean is now of relatively little importance. It is known from ancient archaeological levels in Peru (19, 55, perhaps not this species?), and is reported from archaeological evidences in North America (116). It may be that this large-seeded species was cultivated very early, but has since declined in popularity and usage due to the development of the better types of *Phaseolus* beans (177). Piper (147) considers it "practically certain that the plant is native to America." Its nearest relatives appear to be Mexican, Central American and West Indian in distribution. Vavilov (207) assigns it to the Mexican-Central American center of origin (diversity) with a query. (55, 115, 117, 147*, 207)

**Capsicum annuum** *L.*, **C. frutescens** *L.*: Chile Pepper.

The importance of the chile in Mexican diet is well known and doubtless of great antiquity. The common species, *C. annuum* and *C. frutescens*, have long been confused, but Smith and Heiser (187) have recently found that they appear to be truly distinct with strong sterility barriers preventing hybridization. Both species include

perennial forms in the tropics. The slight, but fairly constant, morphological differences listed by Smith and Heiser include characters that sometimes serve to distinguish the seeds of the two species, a fact which should be of interest to archaeologists. Centers of diversity for the peppers occur both in Mexico and in Brazil (206). The small-fruited peppers are weedy and now occur spontaneously throughout the tropics. *C. frutescens* is found under seemingly natural conditions in the canyons of northwestern Mexico (81) and even as far north as the Baboquivari Mountains in Arizona (41). Too little is now known to determine with any certainty the origin of either species. They may have spread as useful weeds at a very early date and then been cultivated independently in two or more areas. (25*, 31, 41, 81, 92, 92a*, 93, 106, 187*, 196, 206)

*C. pubescens* R. & P., distinguished by purple flowers and purplish-black seeds, is known from both Central and South America (92).

**Carica Papaya** *L.:* Papaya.

The papaya, an herb of tree dimensions with melon-like fruit, is believed to have been known to the Mayan and perhaps to the Aztec cultures (113, 149). Several wild and cultivated species of this genus are found in South America, but Solms-Laubach (188) considered *C. Papaya* to be most closely allied to wild forms occurring in Mexico and the West Indies. Hybridization may have played a part in the origin of the cultivated form. Sauer (177) gives reasons for believing it to be Central American. (113, 133, 149, 177*, 188*, 191*, 192)

The smaller-fruited *C. cauliflora* Jacq., which ranges south to Colombia and Venezuela, is listed by Standley as cultivated and perhaps native in Veracruz and Chiapas (191).

**Casimiroa edulis** *La Llave & Lex.*: *Iztaczápotl, cochitzápotl, sapote blanco*, white sapote; **C. Sapota** *Oerst.*: *matasano.*

These trees are grown in Mexico and Central America for their sweet fruits, which apparently vary in quality. A good account is given by Martínez (136). *C. edulis*, the sapote blanco, is Mexican in its present occurrence, while *C. Sapota*, the matasano, is largely Central American. These distributions probably reflect their origins. (133, 136*, 153, 191, 199)

**Chamaedorea Tepejilote** *Liebm.*, **C. Wendlandiana** (*Oerst.*) *Hemsl.*: *Tepejilote, pacaya.*

At least one, and probably several, species of the small, attractive palm, *Chamaedorea*, are cultivated in southern Mexico and Central America for the young staminate flower clusters, which are used as a vegetable. The unopened inflorescence is said to resemble an ear of maize in appearance and, at times, in size. Standley (193) reports them to be quite palatable. *Chamaedorea*, like most palm genera, is in need of study, and the names given here are, at best, tentative. (31, 191, 192, 193*)

**Chenopodium Nuttalliae** *Safford* (*C. pueblense* Reed?): *Cuauhzontli, huauhtzontli, apazote.*

Though less well known than the species cultivated in South America, this Mexican *Chenopodium* was of some importance, as indicated by its present relict occurrence in cultivation in many parts of Mexico (159, 172). It now is used principally as a green vegetable (the unripe fruit clusters), though it may have been used to some extent as a cereal, as are the South American species. *C. pueblense* Reed (58) was not distinguished from *C. Nuttalliae* by its author and may be the same species. *C. Nuttalliae* is closely related to *C. Quinoa* Willd. of the

Andean area, and Aellen (3) and others have considered it to be that species. The supposed diffferences in seed color are of no value. Hunziker (102), however, points out floral differences between the two plants. While *C. Quinoa* has close allies occurring wild in the Andean region, the situation as regards the Mexican *Chenopodium* is not clear. It may have been derived from the South American species in cultivation, though Aellen (1) implies a relationship to the North American *C. Berlandieri* Moq. A careful study of these plants should be rewarding. (1, 2, 3, 101, 102*, 143, 158, 159*, 172*, 178)

*C. ambrosioides* L. (Apazote or wormseed) is widely distributed and has medicinal uses. It is said to be cultivated at times (17, 194).

**Cnidosculus Chayamansa** *McVaugh* (*Jatropha aconitifolia* Mill.): *Chaya, chay.*

The chaya is a shrub cultivated in the Yucatan area for its young shoots and leaves, which are eaten as a pot herb. It is related to *C. aconitifolia* (Mill.) I. M. Johnst. and *C. Chaya* Lundell, both of which are more abundantly supplied with the stinging hairs which have earned *Cnidosculus* the generic name of "Mala mujer" in Mexico. The less objectionable forms of *C. Chayamansa* have doubtless been selected under cultivation. (113, 114*, 118*, 166, 192, 193, 196)

**Cocos nucifera** *L.; Coco,* coconut.

There has been a good deal of controversy concerning the pre-Columbian distribution of the coconut. There is now little doubt of its Old World origin. Bruman (29), after a review of the historical data, has concluded that the coconut did occur in Colima and probably elsewhere on the west coast when the first Europeans arrived. It was no doubt used by the natives, but may or may not have been cultivated. (29*, 177a, 191)

**Crataegus pubescens** (*HBK.*) *Steud.* (*C. mexicana* Moc. & Sessé, *C. stipulosa* (HBK.) Steud.): *Texócotl, tejocote, manzanilla.*

The tejocote is still widely cultivated in Mexico and Guatemala for the apple-like fruit which is eaten raw or variously cooked. These are probably the apples referred to by Pomar (158) as being equal in size and flavor to the Spanish "San Juan" apples. Standley and Steyermark (194) consider it to be a native of Mexico introduced into Guatemala. (9, 18, 133, 143, 153, 158, 191, 194*, 206, 207)

**Crescentia Cujete** *L.: Jícara, tecomate*, calabash.

The calabash, a tree quite unrelated to the bottle gourd *Lagenaria*, produces a large fruit, the shell of which is used for utensils, as is that of the gourd. It ranges from Mexico to northern South America and occurs also in the West Indies. It is probably native in southern Mexico.

*C. alata* HBK. is a smaller-fruited species of western Mexico and Central America. (191*, 192, 196, 200)

**Crotalaria longirostrata** *Hook. and Arn.: Chipilín.*

This large herb of the legume family is grown in Guatemala and probably southern Mexico as a pot herb. It is apparently native to much of Mexico and Central America. (115, 191, 194*)

**Cucurbita:** *Ayotli, calabaza*, squash, pumpkin.

The pumpkins and squashes occupied a place of importance in the agriculture of both North and South America. In Mexico, they are a valuable source of edible oil seeds and the flowers and young foliage are used as vegetables. It has been suggested that the squashes were

utilized for their edible seeds long before the flesh was eaten (7, 36), because the flesh of all the known wild species is scant, bitter and unpalatable. Whitaker and Bohn (216) have summarized the available information on all the cultivated species.

**C. ficifolia** *Bouché* is a perennial species known from Mexico to Chile at higher altitudes. It is believed to have occurred in Peru at a very early time, but its origin is not known. Like *Canavalia*, this may be a very ancient cultigen which has since been largely replaced by the other and superior species.

*C. maxima* is a South American species which did not reach Mexico in pre-Columbian times.

**C. mixta** *Pang.* is believed by Whitaker and Bohn to be the same as the Mexican form of *C. moschata*, though the Russian workers (31, 146) believed them to be distinct and list two varieties of *C. mixta*, one from Mexico and the other from Guatemala.

**C. moschata** *Duch.* occurs from the southwestern United States to Colombia, though the South American forms seem to constitute a group distinct from those of Mexico and Central America. The origin of this species has not yet been determined, but it may be Central American.

**C. Pepo** *L.* is believed to have arisen from *C. texana* Gray of the southern United States, or a similar wild plant. It has been suggested (36) that this species was independently domesticated in the southwestern and in the southeastern United States; while this may be so, the endemic forms known to occur in Mexico and Central America (31, 36) should be considered in any study

of the species. (9, 12, 13, 31, 36, 113, 115, 146, 177a, 200, 206, 207, 214, 216*, 217*, 220)

**Dahlia coccinea** *Cav.* (*D. rosea* Cav.); **D. pinnata** (*Cav.* (*D. variabilis* Desf.); **D. Lehmannii** *Hieron.* (*D. Maxonii* Saff.): *Acocoxóchitl, acocotli,* dahlia.

That dahlias had long been cultivated before their discovery by Europeans is indicated by the great degree of variability which these plants showed when first introduced into Europe, and by the great variety observed by Hernández (93, 173, 183). The tuberous roots of the dahlias are edible, and Camp (34) believes that they were first cultivated as food plants. The huge "tree" dahlias, *D. Lehmannii* (*D. Maxonii*) and perhaps *D. excelsa* Benth., are much cultivated in southern Mexico and Guatemala, where they serve as living fences. There is no comprehensive study of these plants available, and their relationships are but poorly understood. It is almost certain that hybridization has played a considerable part in the origin of the cultivated forms, some of which are polyploids. (34, 62, 173*, 183*, 184)

**Diospyros Ebenaster** *Retz.: Tlilzápotl, zapote prieto,* black sapote.

Though a popular fruit in parts of Mexico, the black sapote is found unattractive by some because of its dark colored pulp. It is related to the better known persimmon and produces a fruit of good size. Some have thought it a native of the East Indies, but the evidence seems to indicate a Mexican origin (138). There is no recent study of this genus. (31, 95, 133, 138, 153*, 164*, 191, 199)

**Gossypium hirsutum** *L.: Íxcatl, algodón,* cotton.

Cotton was an important fiber plant in much of Amer-

ica and is of special interest in that it has recently been the subject of detailed cytogenetic investigation (105). The cytological evidence shows that the New World cottons are allopolyploids (amphidiploids); that is, a type of stable hybrid which arises through the doubling of chromosomes in the progeny of an interspecific cross. One of the parents of the American allopolyploid cottons was *G. Raimondii* Ulbrich of Peru, or a similar (perhaps ancestral) type, while the other was an Old World type similar to *G. arboreum* L. While the explanation offered by Hutchinson, Silow and Stephens (105), that the Old World cotton was carried across the Pacific by man, has been the subject of some controversy, we are here primarily concerned with the evidence that the American cultivated cottons arose in the Andean region.

The Mexican cotton, *G. hirsutum*, appears to have arisen, *as a species*, in the south Mexican-Guatemalan region. Three varieties of this species were recognized at the time of the comprehensive work cited above, but Hutchinson (104) has since been able, with more adequate material, to recognize seven geographic races, five of which are cultivated in Mexico, a sixth occurring only in the naturalized state in coastal Yucatan. The seventh race, "Marie-Galante," the most primitive of the group, occurs extensively in Central America, the West Indies and northern South America.

The evidence that the distinct species, *G. barbadense* L., of South America, and *G. hirsutum*, have differentiated from a common ancestor while under cultivation is of very great interest. This implies a considerable antiquity for agriculture in both hemispheres and shows that definite conclusions concerning the relationships and origins of cultivated plants can be reached only after the most careful study. (104*, 105*, 133, 164, 191, 194, 203, 206, 207, 210)

**Helianthus annuus** *L.*: *Acahualli, chimálatl, chimalácatl, maíz de teja, girasol,* sunflower.

The sunflower is to be counted among the cultivated plants of early Mexico, as shown by the endemic varieties occurring there and by the descriptions of the early writers (90, 93). The cultivated sunflower, *H. annuus* var. *macrocarpus* (DC.) Ckll., which was also grown in the eastern, central and southwestern United States, is thought to have been derived from the wild *H. annuus* var. *lenticularis* (Dougl.) Ckll., which is widespread in the western United States and is limited in Mexico to the northern states. A form from Jalisco is found to resemble the Hopi sunflower as well as archaeological material from the eastern United States. While the history of the cultivated sunflower cannot yet be given in detail, it would appear to have arisen to the north of Mexico, where the wild form occurs and archaeological remains indicate long usage by man (185). (5, 89, 90*, 91*, 133, 185).

**Hylocereus undatus** (*Haw.*) *Brit. & Rose: Pitahaya.*

The cacti, which are so prominent in the landscape of the more arid regions, were of great importance to the early inhabitants, and a number were cultivated (see also *Opuntia*). The present species, a climbing vine, is widely grown on walls and fences as an ornamental and as a source of large edible fruits. (17, 24, 26*, 28, 68, 191)

**Hyptis suaveolens** *Poit.*: *Chía grande, chía de Colima, chan.*

The seeds of this labiate are used in the same manner as those of *Salvia hispanica* and it frequently goes under the same common name, *chía.* Like that species, it is a somewhat variable and weedy plant and now occurs in

many parts of the tropics. It is known in cultivation principally in western Mexico from Sonora and Chihuahua to Oaxaca, and perhaps in San Luis Potosí. (75*, 133, 145*)

**Indigofera suffruticosa** *Mill.* (*I. Anil* L.): *Xiuquílitl, jiquelite, añil,* indigo.

This American species of indigo was apparently cultivated in Mexico and Guatemala as a source of a blue pigment used extensively to dye clothing; it was also used by the Mexican women to tint their hair (93, 172). The cultivation of indigo for export was promoted by the Europeans, but has declined because of the development of synthetic dyes. The plant is now widespread as a weed and may have had a rather extensive natural distribution (33). Its cultivation probably originated in the Guatemala-southern Mexico area. (33*, 115, 133, 155, 162, 166, 191, 192, 194*, 201)

**Ipomoea Batatas** (*L.*) *Poir.: Camotli, camote, batata,* sweet potato.

The sweet potato was and is extensively grown in Mexico, the region of Querétaro being long noted for the excellence of this crop. It was not only widely grown in tropical America, but in Polynesia as well, a fact which has led to much discussion (58, 69, 99). Vavilov (207) assigns it to the south Mexican-Central American center of origin (diversity), though some other writers favor a South American origin. *I. tiliacea* (Willd.) Choisy (*I. fastigiata* (Roxb.) Sweet) is thought to be the ancestral form (58, 100), but its present distribution is too broad to pin-point the area in which it was first cultivated. It ranges from Florida and Mexico to South America. The information presently available seems inadequate to reach a conclusion as to the exact geographic origin of *I. Batatas.* (49, 58*, 69, 100*, 133, 197, 202, 207)

**Jatropha Curcas** *L.*: *Piñoncillo*, physic-nut. (see also *Cnidosculus.*)

McVaugh (119) says of this species: "The original range of *J. Curcas* doubtless included the *tierra caliente* of southern Mexico and Central America, but as it is widely planted and has been so since before the advent of Europeans . . . " Now of wide distribution in the tropics, this shrub or small tree is planted as a hedge and has medicinal uses. The seeds are said to be edible if thoroughly roasted, but are strongly purgative when fresh. *Jatropha* and *Spondias* were used as host plants for a coccid insect, the *axi* or *axin*, which was cultivated in Veracruz for a yellowish wax which it produced. This is a "domesticated animal" of the Mexicans which is not well known. The wax was and is used as a varnish and also had medicinal uses. (119*, 133, 191*, 194, 200)

**Lagenaria siceraria** (*Mol.*) *Standl.* (*L. vulgaris* Sér.): *Tecomate*, *bule*, bottle gourd.

The gourd is still of some importance in primitive cultures and must have been much more so to non-ceramic groups. It is thought to be a native of the Old World, perhaps of Africa, but is known from archaeological evidence to have had a very wide distribution in America at an early time. *L. siceraria* is the only species in the genus, but the closely related genera are Old World plants. Kobiakova (109) has attempted a preliminary study of this species and believes that the American gourds are derived from Africa. However, this study is admittedly based on insufficient material and American students (72, 141) have found it to be inadequate. The dispersal of the bottle gourd in America may parallel that of cotton. (51, 72*, 108, 109, 141, 177a, 198, 215*)

*Lemaireocereus:* see under *Pachycereus.*

*Lucuma:* see *Pouteria.*

**Lycopersicon esculentum** *Mill.: Xitómatl, jitomate, p'ak, tomato.*

The wild species of *Lycopersicon* are native to western South America, and it has long been thought that the cultivated tomato was brought into Europe from Peru. Jenkins (107), however, has given good reasons for believing that the tomato was introduced, with its Mexican name, from Mexico to Europe. It appears that the tomato was cultivated in southern Mexico and Veracruz, but not in the central Mexican highlands, where *Physalis* (q. v.) was, and still is, more important. The cherry tomato, *L. esculentum* var. *cerasiforme* (Dun.) A. Gray, the ancestral form, is now a pan-tropic weed. It is thought by Jenkins that it may have spread as a weed from South America to Mexico where it was brought into cultivation. It may be that the development of large-fruited forms was facilitated outside of the native home, because the absence of the normal pollinating agents forced self-pollination (161). (107*, 111, 112, 142, 161)

**Manihot esculenta** *Crantz* (*M. utilissima* Pohl), **M. dulcis** (*J. F. Gmel.*) *Pax* (*M. Aipi* Pohl): *Quauhcámotl, guacamote, yuca,* manioc.

Manioc, a starchy root crop, was cultivated as a vegetable in Mexico, though not of such importance there as in some other areas, where it is a staple food. The genus is deserving of careful study, and it is uncertain, from the available literature, whether *M. dulcis* is not one of the "sweet" varieties of *M. esculenta.* The plants of Mexico appear to have been largely of these "sweet" or less poisonous forms (4, 177). Manioc is generally thought to be of Brazilian origin, but, here too, a careful study is much to be desired. (4, 35, 71, 93, 113, 133, 177a, 179, 191, 194*, 196, 202)

**Manilkara Zapotilla** (*Jacq.*) *Gilly* (*Achras Zapota* L.): *Tzicozápotl, chicozapote,* sapodilla.

The sapodilla is widely cultivated in tropical America as a fruit tree, and the wild trees are of importance as the source of chicle, a substance known and used by the ancient Mexicans. Its wood is extremely durable and is said to have been used by the Mayas in temple construction. The name "*Achras Zapota*" is well established in the literature, though there may be good botanical and nomenclatural reasons for abandoning it (82). Further study or action of the International Botanical Congress may conserve the older and better known name. *Manilkara Zapotilla* is a highly variable species, thought to be native from southern Mexico to Costa Rica. (63*, 82*, 133, 153, 191)

**Nicotiana Tabacum** *L.*; **N. rustica** *L.*: *Yetl, picietl,* tobacco.

Various species of tobacco were cultivated and used almost throughout the Americas. There is no agreement as to which species was the most important in pre-Columbian Mexico. Setchell (182) considered *N. Tabacum* to be the principal tobacco of Mexico, while Spinden (190) considers *N. rustica* to have been the only species cultivated there, at least in the central highlands. It is probable that *N. Tabacum* was known and cultivated at least in southern Mexico. The plant figured by Hernández (Plate XX) is clearly *N. rustica*, but the "quauhyetl" which he mentions may be *N. Tabacum*.

*Nicotiana* has been the subject of intensive cytogenetic study with results of value both to botany and to anthropology. Like the New World cultivated *Gossypium*, both of these species of tobacco are allopolyploids. *N. rustica* appears to have arisen as a hybrid between the progenitors of two modern species which occur in the

Peruvian Andes (83, 84), while *N. Tabacum* probably arose in a similar manner on the eastern slopes of the Andes, perhaps in the region of Northern Argentina (84, 88). The latter, at least, is not known from the wild state (85), and it or both may have arisen in cultivation. From their distribution at the time of European discovery, it would seem that *N. rustica*, which was then the cultivated tobacco of the eastern United States, was the first to be cultivated, or at least the first to be widely dispersed. *N. Tabacum*, arising or entering cultivation at a later date, was superior to the earlier species, especially at lower altitudes, and largely replaced it in South America and parts of Middle America. The European cultures served to hasten the replacement of *N. rustica*, and it is still peripheral in its distribution, being grown principally as a garden tobacco in the Old World. It may be that indigenous species of tobacco were early cultivated in Mexico, as they were in much of the western United States (182), and later replaced by the South American species. A monograph of *Nicotiana*, by Goodspeed, is in press and should be of interest. (83, 84*, 85–88, 93, 177a, 182*, 190, 196a)

**Nopalea cochenillifera** (*L.*) *Salm-Dyck: Nopal nocheztli.*

A cactus similar to *Opuntia* in aspect, this species is well known as the plant on which the early Mexicans cultivated the cochineal insect, the source of a highly valued red dye (26). This cactus is spineless, apparently the result of selection under cultivation. This species of *Nopalea* is probably native to some part of southern Mexico. The present cultivation of cochineal in Oaxaca is said to utilize varieties of *Opuntia ficus-indica*. (24, 26*, 49, 68, 93, 158, 191*)

**Opuntia ficus-indica** (*L.*) *Miller;* **O. megacantha** *Salm-Dyck;* **O. streptacantha** *Lemaire;* **O. amyclaea** *Tenore: Nochtli, nopalli, tuna* (fruit), *nopal* (plant), prickly pear.

*Opuntia*, which figures in the ancient Mexican symbol of the eagle and the *nopal*, is and has long been of great economic importance in parts of Mexico. The early writers were impressed by the great variety of tunas or *nochtli* in the Mexican gardens and markets (93, 158, 174). Several species are extensively grown for their edible fruits, which are variously prepared, and the young stems, or "joints," are used as a vegetable. The plants are easily multiplied by cuttings, so that fine hybrids and varieties can be selected and propagated true to type. Most of the cultivated Opuntias are doubtless native to central Mexico. (17, 24, 26*, 28, 49, 68, 93, 158, 164, 174, 191*)

**Pachycereus emarginatus** (*DC.*) *Brit. & Rose: Órgano, pitayo.*

This cactus is used for picturesque living fences in many parts of Mexico. Other columnar types, such as species of *Lemaireocereus*, were probably also cultivated for fruit, protection and ornament. (24, 26*, 28, 68, 191)

**Pachyrrhizus erosus** (*L.*) *Urban: Xícama, jícama,* yam bean.

The yam bean is extensively cultivated in Mexico for its turnip-like roots, which are usually eaten raw and are said to be very palatable. It appears to be native to lower elevations in central and southern Mexico and northern Central America, and is now widely cultivated and naturalized in many parts of the world. Other species were cultivated in South America. (17, 48*, 113, 133, 192, 202)

**Panicum sonorum** *Beal: Sauwi*, panic grass.

This is a little-known grass cultivated by the Warihio of Sonora and Chihuahua as a cereal (81). It is said to have been cultivated also by the Cocopa (41, 96). It is probably an indigenous cultigen of this area, though the species also occurs in southern Mexico. It is of particular interest since very few true cereals, other than maize, were cultivated in the New World. Two South American grasses of similar status are now believed to be extinct (177). (41, 81*, 96).

**Parmentiera edulis** *DC.: Quauxílotl, cuajilote.*

This tree, related to the calabash, is cultivated in many parts of Mexico for its sweet fruits which are eaten either raw or variously cooked. The tree now ranges from Tamaulipas and Sinaloa to Central America and is probably native at least to southern Mexico. (17, 133, 191*, 200)

**Persea americana** *Mill.: Ahuácatl, pahua, aguacate*, avocado; **P. Schiedeana** *Nees: Chinini, coyó.*

The nutritious avocado, now becoming more popular in the North, has long been an important food in Middle America. There are three groups recognized within *P. americana:* the Mexican race, a thin-skinned, small-fruited type centering in the Mexican highlands and sometimes designated as *P. americana* var. *drymifolia* (Schlecht. & Cham.) Blake; the Guatemalan race, principally Central American; and the "West Indian" race which occurs in the lowlands of Central America and northern South America. Williams (219) states that the complex of wild forms, to which *P. americana* is most closely related, ranges from Mexico to Honduras and probably to Costa Rica. Popenoe (152) has found what he believes to be wild trees of the Mexican race on the slopes of Orizaba and supposed wild trees of the Guatemalan

race in central Guatemala. These probably indicate the centers of origin of these two cultivated races from varieties of the same species or from closely related species. The West Indian race, which may not have occurred in Mexico until recent times, seems to be more closely related to the Guatemalan race than to the Mexican and probably arose somewhere in lowland Central America. Hybridization may have played some part in the development of these races and certainly has been important in the formation of the modern commercial varieties (8). (8, 21, 97*, 133, 152, 191, 194*, 219)

*P. Schiedeana* is a distinct species ranging from southern Mexico to Panama, but it is rarely cultivated except near Orizaba, Mexico, where it is of considerable importance (153).

**Phaseolus:** *Ayecote, bul, frijol,* bean.

The bean is one of the ancient American trinity, maize-bean-squash, and is nowhere more important than in Mexico. The genus is not as well known as its economic value merits. A recent Russian paper, which the present author has not seen, is cited by Carter (36). Several species of beans are cultivated in Mexico:

**P. acutifolius** *A. Gray:* Tepary.

This species is less important in Mexico than it is in the southwestern United States, where its resistance to drought and heat give it a great advantage over *P. vulgaris* and where it has its center of diversity. The wild forms of the tepary bean occur from western Texas to Arizona and southward to Jalisco. The most probable center of origin for the cultivated plant is northwestern Mexico (36). It is now found in cultivation in Chiapas and Guatemala, but its antiquity in these regions is not known (36, 79*).

**P. coccineus** *L.* (*P. multiflorus* Willd.): *Ayécotl, címatl,* scarlet runner bean.

This species appears to be known in the wild state in Mexico and Guatemala (148), and is thought by the Russian workers (31) to have its center of diversity in Guatemala. It appears to be of some importance both in Mexico and in Guatemala. The fleshy root may also have been eaten (202).

**P. lunatus** *L.:* Lima bean.

This species, too, is known as a wild plant in Mexico and Guatemala. Mackie (117) places its center of diversity and origin in Guatemala and traces three routes of diffusion from this center, each with a different type. One group of the lima bean, the northern or "Hopi" branch, was dispersed northward through Mexico and into the United States. A second group, the "Inca" branch of the species, extends into Andean South America and includes the varieties with the largest seeds. The third group, the "Carib" branch, occurs in the West Indies and lowland South America. While the routes followed by these three groups may not be quite as traced by Mackie (36), the groups and trends seem to be valid. For a discussion of the synonymy of this species and its subdivisions see Van Eseltine (204).

**P. vulgaris** *L.: Bul, frijol,* common bean.

This is the most important bean of most of America. The center of diversity of this species is in Mexico and Guatemala (31), and wild plants of *P. vulgaris* have been found in this region in recent years (115, 177). The center of origin for this important species was probably somewhere in the Mexican-Guatemalan area, though Burkart (33a; pp. 429, 545) reports what he believes to be wild forms of this and of the preceeding species from Argentina. (31, 36*, 37, 79, 115, 117*, 133, 158, 194*, 204)

**Physalis ixocarpa** *Brot.: Tómatl, miltómatl, tomate, tomatillo,* husk tomato.

This is an important plant in the central Mexican highlands where the fruits are used in stews and sauces. The fruits are quite large and the plants highly variable. In some areas two varieties are recognized, at least in the markets; one with the husk close-fitting about the fruit and the other with a larger husk. These seem to be the two forms illustrated by Rose (164). The species is probably native to central Mexico. The cultivated *Physalis* of the Guatemalan highlands is usually referred to *P. pubescens* L., but may be *P. ixocarpa* or some other species. *P. peruviana* L., of South America, is not closely related. (115, 137*, 149, 164, 167, 193)

**Polianthes tuberosa** *L.: Nardo,* tuberose.

The tuberose, a widely cultivated ornamental, is not definitely known as a wild plant, but it is almost certainly a native of Mexico, as are the other species of the genus. Double forms are frequent, and the plant probably has a long history of cultivation. (14, 165*, 194*)

**Pouteria campechiana** (*HBK.*) *Baehni* (*Lucuma salicifolia* HBK.): *Costiczápotl,* yellow sapote.

This fruit tree ranges from southern Mexico to Panama, but is cultivated principally in Mexico according to Popenoe.

*P. hypoglauca* (Standl.) Baehni, a similar species, is cultivated and perhaps native from San Luis Potosí and Veracruz to northern Central America. (64*, 153*, 191, 199)

**Protium Copal** (*Schlecht. & Cham.*) *Engler: Copal, pom.*

This tree was important among the ancient Maya for

its resin, which was used principally as an incense in religious ceremonies and which is still of considerable importance in highland Guatemala (194). Although the tree is reported as having been cultivated at the time of the conquest (196), the resin is now obtained from wild sources. *P. Copal* is restricted to southern Mexico and northern Central America and is doubtless native there. (192, 194*, 196*)

**Prunus serotina** *Ehrh.* subsp. **Capuli** (*Cav.*) *McVaugh* (*P. Capuli* Cav., *P. salicifolia* HBK.): *Capulín, cereza*, capulin cherry.

The Mexican cherry was noted by the early European observers as equal in size and quality to the European cherries but of a different flavor (49, 93, 191). It is apparently native to the Mexican highlands, though early introduced into South America, where it is now much grown, especially in Ecuador (154, 194). Cobo (50) tells of its introduction into Peru. McVaugh (120) has reemphasized the close relationship of the capulin to *P. serotina* subsp. *serotina*, a wild cherry of the United States and Mexico. (49, 50, 120*, 133, 153, 154*, 158, 191, 194*)

**Psidium Guajava** *L.: Xalxócotl, jalocote, guayaba*, guava; **P. Sartorianum** (*Berg.*) *Niedenzu; Arrayan, guayabilla.*

The guava is a shrub or small tree which is widely distributed in tropical America and, though valued for its edible fruit, may occur in such abundance as to be a weed and a nuisance. *P. Guajava*, the best known species, ranges from Mexico to Peru. Whether or not man played a part in bringing about this range, it is difficult to determine. *P. Sartorianum*, of Mexico and Central America, is also cultivated to some extent.

*P. Friedrichsthalianum* (Berg.) Niedenzu is largely Central American and may never have been cultivated in Mexico. The wide ranging *P. guineense* Sw. (*P. molle* Bertol.) is apparently inferior and little grown. (116, 133, 149, 150, 151*, 191*)

**Salvia hispanica** *L.* (*S. Chian* La Llave, *S. polystachya* Ort.): *Chía, chiantzozolli* (see also *Hyptis*).

The seeds of *chía* are widely used in Mexico to prepare a nourishing and refreshing drink which is highly esteemed by many. They may be toasted and ground or merely stirred into water, and produce a copious mucilaginous jelly. This drink is frequently sweetened and variously flavored. The seed has also long been the source of an excellent drying oil used in painting. This species is evidently a native of central Mexico. Bukasov (31) states that it is also cultivated in Guatemala (as *S. Chia* Fern.). (31, 49, 74*, 110, 133, 145*, 162)

**Sambucus mexicana** *Presl.: Sauco*, elderberry.

This shrub or small tree is occasionally seen in gardens or hedgerows (personal observation) and is said to be cultivated for its small fruits (191). The available information concerning this plant is inconclusive. (17, 191)

**Sechium edule** *Sw.: Chayotli, chayote, güisquil.*

The chayote has long been an important cultivated plant in Mexico. Not only are its somewhat squash-like fruits produced in abundance, but the young leaves and shoots are useful as greens, and the large, starchy roots are also eaten, only a part of the root cluster being harvested at any one time to avoid killing the vine. The greatest diversity of this species occurs in Guatemala, where a wild form is said to occur (115, 206). (9, 56, 98*, 115, 133*, 193, 202, 206)

**Solanum tuberosum** *L.*: *Papa*, potato.

While the potato seems scarcely to be considered as a pre-Columbian cultivated plant of Mexico, McBryde's observation of a small, semi-cultivated form ("*S. andigenum* Juz. & Buk. forma *guatemalense* Buk.") in Guatemala, which he considers to be a pre-Columbian introduction from South America, deserves attention (115). If this potato was actually pre-Columbian, it would appear that cultivated *S. tuberosum* was present in Middle America, but that it was not sufficiently attractive to the people of this region to spread widely. Close relatives of *S. tuberosum* occur in Mexico and the tubers of wild plants were utilized to some extent. Correll (60) interprets *S. tuberosum* and *S. andigenum* as ecological forms of one species. (60, 115)

**Spondias purpurea** *L.*: *Xócotl, jocote, jobo, ciruela;* **S. Mombin** (*S. lutea* L.): *Jobo, coztícxócotl, ciruela amarilla.*

The jocote is a widespread and important fruit tree in Mexico and Central America. It is easily propagated by cuttings and is therefore often grown as a hedge or fence-row plant. *Spondias*, like *Jatropha* (q. v.), was used as a host for the wax-producing coccid insect, *axin*. *S. purpurea*, the better known of the two species, is widespread in tropical America and probably native in parts of Middle America, and perhaps elsewhere. *S. Mombin* is generally stated to be inferior and less cultivated; it is probably a native of Central America and perhaps also of southern Mexico. Both species are highly variable and a careful study of *Spondias* would be most welcome. (133, 153, 164*, 191, 192, 194*)

**Tagetes patula** *L.*; **T. erecta** *L.*: *Cempoalxóchitl, flor de los muertos*, marigold.

Species of *Tagetes* are widely used in Mexico as medicinal plants and at times seem to carry some ceremonial significance (17, 164). The showy and variable *T. erecta* and *T. patula* must, like the dahlia, have had a long history of cultivation as ornamentals in Mexico. (17, 49, 50, 93, 133*, 143, 164, 192)

**Taxodium mucronatum** *Ten.: Ahuéhuetl, ahuehuete,* Mexican bald cypress.

Though perhaps not properly listed as a cultivated plant, the noble *ahuehuete* surely deserves mention. It is known to have been planted by the ancient Mexican rulers in their parks and gardens, and a number of the trees thought to have been planted by Netzahualcóyotl and Moctezuma II are still living. A good account is given by Martínez. (135*, 191)

**Theobroma Cacao** *L.;* **T. angustifolium** *DC.: Cacao;* **T. bicolor** *Humb. & Bonpl.: Patachtli, pataxte.*

Cacao was highly valued in Mexico as the source of *xocóatl*, a drink somewhat different from the modern chocolate. The seeds were often used as a medium of exchange. *T. Cacao* is a rather variable population and some authors have recognized several species on the basis of fruit shape and other characters. Cheesman (45) recognizes two main groups. The "Criollo" varieties, with plump seeds and pale or unpigmented cotyledons, produce the highest quality of seeds, and are thought to be the original cacao varieties of Mexico and Central America. These are known to occur also in Colombia and Venezuela, but were apparently not cultivated there in pre-Columbian times. The "Trinitario" varieties (*T. leiocarpa* Bernoulli), with flattened seeds and purple cotyledons, have been brought into cultivation in relatively recent times from wild Amazonian trees. The early de-

scriptions by Sahagún and Cobo (50, 174), however, seem to refer to "Trinitario" varieties in Mexico rather than to "Criollos"; perhaps the seed of *T. angustifolium* resembles that of the "Trinitario" forms. The present commercial cacaos of America are mostly hybrids involving both groups. Cheesman places the "center of origin" of *T. Cacao* in the upper Amazon. This may have been a center of dispersal of wild *T. Cacao*, but it was clearly brought into cultivation somewhere in Central America or southern Mexico. For the purpose of the anthropologist, a distinction must be drawn between the origin as a cultivated plant and the history of the plant before cultivation or association with man. The latter subject is, however, of great interest to botanists.

*T. angustifolium*, of Central America and southern Mexico, is said to be cultivated to a considerable extent in Mexico, particularly about Soconusco, Chiapas, and apparently produces a good grade of cacao (191, 194). *T. bicolor* ranges from southern Mexico to northern South America and is generally considered inferior in quality to *T. Cacao*, but is cultivated and used in some areas. (44, 45*, 46, 49, 50, 70, 71, 133, 191*, 194*)

**Tigridia pavonia** (*L.f.*) *Kerr.*: *Ocelox̆óchitl*, *cacómitl*, *cacomite*, tiger-flower.

Now known principally for its beautiful flowers, the tiger-flower was cultivated by the Mexicans for its edible corms as well as for ornament. It is evidently a native of central Mexico. (50, 93, 133*, 143)

**Vanilla planifolia** *Andr.* (*V. fragrans* (Salisb.) Ames): *Tlilx̆óchitl*, *vainilla*, vanilla.

Vanilla was known to the Mexicans and used especially for flavoring chocolate. This vine occurs from tropical Mexico to northern South America, but its pre-Colum-

bian use extended only south to Costa Rica (30). In Mexico its cultivation has long centered in southern Veracruz, and it was probably little cultivated in other areas. (30*, 59*, 60a*, 133)

**Yucca elephantipes** *Regel: Iezotli, izote*, yucca.

This large tree is much planted for hedges, especially in Central America, where it is apparently introduced. The flowers are valued as a vegetable. Standley (192) considers it to be a native of Veracruz. *Y. aloifolia* L. is also cultivated at times. (115, 133, 191*, 192, 193, 194*)

**Zea Mays** *L.: Tlaolli, centli, maíz*, maize, Indian corn.

Maize has long been the most important crop plant for most of the Americas and certainly retains that title in Mexico. The interest in this plant has been such that an overwhelmingly voluminous literature has developed concerning the genetics, cytology, morphology, relationships, importance and origin of this cereal. There remain, nonetheless, many unanswered questions about maize and it will doubtless provide a fertile field for investigators for many years to come.

The nearest ally of maize is teosinte, *Euchlaena* (*Zea*) *mexicana*, which occurs apparently as a wild plant in Guatemala and Chiapas and as a weed of cultivated areas in many parts of Mexico. Teosinte has at times been thought to be the wild ancestor of maize, but this idea now has very few adherents. Mangelsdorf and Reeves (129) have suggested that teosinte is actually of hybrid origin, maize and a species of *Tripsacum*, a more distantly related grass, being the parent species. Stebbins (193, p. 277) suggests that a cross might have been more readily effected between primitive maize and some extinct species of *Tripsacum*, with a lower chromosome

number, than between the modern representatives of these genera, which cross only with difficulty. Though there is not total agreement as to the origin of teosinte, there can be little doubt that it has played a major role in the evolution of modern maize, through hybridization and introgression. Mangelsdorf and his collaborators (123–131) have supported the hypothesis that the most primitive maize is both tunicate (a pod corn) and a popcorn. This seems to have been supported by archaeological and other studies (131, 213). Mangelsdorf and Reeves further hypothesized that the ancestral region for maize should be sought in the South American lowlands, where some primitive forms are still found. More recent evidences seem to indicate a peripheral nature for these South American types. There is paleontological and archaeological evidence that maize is of greater antiquity in North America than in South America (16, 77, 131). Maize pollen was recovered at a depth of seventy meters in the Valley of Mexico; this is interpreted as representing wild maize growing in that region in the Pleistocene (16, 67, 77, 181). Archaeological material from Bat Cave, New Mexico is of particular interest (131). The maize from the lowest level of these deposits (about 2500 to 2000 B.C.) is a very small-eared form and appears to be both a pod corn and a popcorn. Cobs in later levels are larger and show evidences of introgression from teosinte.

Wellhausen et al (213) have recently published a valuable book on the races of maize in Mexico. They have recognized and characterized at least twenty-five distinct races which are grouped into four classifications: "Ancient Indigenous," primitive popcorns of relictual distribution, two of which are weakly tunicate; "Pre-Columbian Exotic," races believed to have been introduced into Mexico from the south in prehistoric times; "Prehistoric Mestizos," derived from races of the first

two categories through hybridization; and "Modern Incipient," less stable races, apparently of relatively recent origin and dispersal. With the basis given by these authors, it should eventually be possible to make an extensive study of archaeological remains of maize from Mexico and adjacent areas and to correlate in time and space these races with their phylogeny and with other culture traits. Indeed, a better framework for American prehistory could scarcely be desired.

The exact origin of maize is yet unknown and will probably continue to be a source of speculation and controversy for some time to come. At present, the evidence seems to favor the Mexican-Central American area as the home of this cereal. The Chiapas-Guatemala area may have been the center of origin for races affected by introgression from teosinte (127). The Andean area has also been a center of dispersal, especially, it would seem, for large-kerneled races, including flour and sweet forms. (6*, 11, 16, 27, 38, 65, 66, 67, 76, 93, 94, 123, 124, 125*, 127*, 128, 129*, 130, 131, 157, 160, 195, 211, 212*, 213*, 218)

## The Geographic Origins of Mexican Cultivated Plants

On the basis of the data which have been discussed, it is possible to arrange the cultivated plants tentatively according to geographic origins. The divisions which are recognized within the Mexican-Central American region do not represent well defined centers or culture complexes, but rather geographic regions with some ecological character. Some plants probably overlap two of these subdivisions in their origins and a few are doubtless assigned to the wrong subdivision. The divisions and assignments are, of course, distinctly tentative and subject to revision.

1. Mexican-Central American Area . . . 71 species[1]

a. Plants whose origins within this area are as yet difficult to localize . . . . . 8 species

*Cucurbita mixta*
*C. moschata*
*Hylocereus undatus*
*Phaseolus vulgaris*
*Theobroma Cacao*
*T. angustifolium*
*T. bicolor*
*Zea Mays*

b. Northern Mexico and the adjacent United States 4 species

*Cucurbita Pepo*
*Helianthus annuus*
*Panicum sonorum*
*Phaseolus acutifolius*

c. Central Mexico (w=western Mexico) 24 species

*Agave atrovirens*
*A. latissima*
*A. mapisaga*
*Amaranthus leucocarpus*
*Annona diversifolia* (w?)
*Casimiroa edulis*
*Crataegus pubescens*
*Dahlia coccinea*
*D. pinnata*
*Diospyros Ebenaster*
*Hyptis suaveolens* (w)
*Opuntia amyclaea*
*O. ficus-indica*
*O. megacantha*
*O. streptacantha*
*Pachycereus emarginatus*
*Persea americana* (Mexican race)
*Physalis ixocarpa*
*Polianthes tuberosa*
*Prunus serotina* subsp. *Capuli*
*Salvia hispanica*
*Tagetes erecta*
*T. patula*
*Tigridia pavonia*

d. Southern Mexico and northern Central America (except for Guatemalan highlands). This is doubtless the least well defined and most inclusive of the subregions delineated here. (y=Yucatan, m=southern Mexico, ca=Central America) 27 species

*Agave fourcroydes* (y)
*A. sisalana* (y)
*Annona purpurea* ?
*Brosimum Alicastrum*
*Byrsonima crassifolia*
*Calocarpum mammosum*
*C. viridis* (ca)
*Carica Papaya*
*Chamaedorea Tepejilote*
*C. Wendlandiana*
*Cnidosculus Chayamansa* (y)
*Crescentia Cujete*
*Indigofera suffruticosa*
*Jatropha Curcas* (m)
*Manilkara* (*Achras*) *Zapotilla*
*Nopalea cochenillifera* (m)
*Pachyrrhizus erosus* (m)
*Parmentiera edulis*
*Persea Schiedeana*
*Pouteria campechiana*
*P. hypoglauca*
*Protium Copal*
*Psidium Sartorianum*
*Spondias Mombin* (ca)
*S. purpurea*
*Vanilla planifolia* (m)
*Yucca elephantipes* (m)

[1] Note that races of the avocado, *Persea americana*, are listed under two subregions.

e. Guatemalan Highlands . . . . . 8 species

*Amaranthus cruentus*
*Casimiroa Sapota*
*Crotalaria longirostrata*
*Dahlia Lehmannii*
*Persea americana* (Guatemalan race)
*Phaseolus coccineus*
*P. lunatus*
*Sechium edule*

2. Andean Area . . . . . 6 species

*Annona Cherimolia*
*Chenopodium Nuttalliae*
*Gossypium hirsutum*
*Lycopersicon esculentum* (or cultivated independently in Mexico)
*Nicotiana rustica*
*N. Tabacum*

3. Lowland South American (Brazil-Paraguay) Region 3 species

*Ananas comosus*
*Arachis hypogaea* (post-Columbian in Mexico?)
*Manihot esculenta*

4. Plants which are at present difficult to assign to any of the above areas, with the author's guesses in parentheses . . . . . 8 species

*Bixa Orellana*
*Canavalia ensiformis* (Mex.)
*Capsicum annuum*
*C. frutescens* (Mex.)
*Cucurbita ficifolia*
*Ipomoea Batatas*
*Lagenaria siceraria* (via Andean region?)
*Psidium Guajava* (Andean?)

From the above lists it will be seen that over eighty species of plants are considered as having been cultivated in Mexico before European contact. Some may think this number to be excessive; it must be recalled, however, that agriculture was developed to a high degree in parts of Middle America and that the ecology of the area is conducive to a great variety of crop plants. In almost all instances, I believe, a very good case can be made for considering these plants to have been cultivated in pre-Columbian Mexico. The greater number are indigenous either to Mexico or to adjacent areas. Some of the indigenous plants are of secondary importance, but the list also includes plants of such prominence as maize, beans, agave, avocado, and species of amaranth and squash. Six species, including cotton and tobacco, are believed to

be of Andean origin. Though the species of cotton in Mexico is not the same as that of the Andean area, it is believed that they both diverged from a common ancestor under cultivation and that cotton culture in the New World stemmed from the Andean area. Two or three plants may be considered as having diffused from lowland South America under cultivation. There remain eight species which the author hesitates to assign to any of these areas. All, of course, are now very widespread, and this portion is not completely comparable to the rest of the list, which includes many local types. It may be expected that several, if not most, will prove to be natives of the Mexican region.

Mangelsdorf and Reeves (129), after a survey of the American cultivated plants, conclude that there had been no direct interchange of crop plants between the Andean and the Middle American areas, but that both regions had received some plants from lowland South America, thus accounting for the relatively few species that occur in both areas. Hutchinson, Silow and Stephens (105), on the other hand, hypothesize an early exchange of plants between these two centers, with little or no subsequent exchange. It is doubtful that "direct" transfer of plants between Mexico and the Andes occurred at any time before European contact. Plants traveled by gradual diffusion and those which occurred in both regions were mostly the ones which could and would be grown in the intervening areas. The indigenous tuber crops of the Andes would do poorly at lower elevations, and there would seem to be little incentive for their cultivation where *Manihot* and *Ipomoea* were both available and better adapted. The different Andean plants in Mexico were probably not of contemporaneous introduction. Cotton was clearly early, as was probably *Chenopodium*, if it is Andean. *Nicotiana rustica* was much earlier than

*N. Tabacum*, and *Lycopersicon* may have been fairly late. If *Annona cherimolia*, *Chenopodium Nuttalliae* and *Solanum tuberosum* are all truly Andean in origin and pre-Columbian in Mexico and Guatemala, a good case might be made for direct transport over a considerable distance; all are plants that thrive only in the temperate highlands.

The plants which are definitely of lowland South American origin are few and of relatively little importance. *Ananas* is almost certainly South American and pre-Columbian in Mexico, *Manihot* is of less certain origin but also pre-Columbian in Mexico, although both may be relatively late. *Arachis* is certainly late and perhaps post-Columbian.

While some of the doubtful domesticates may ultimately prove to be exotic, the bulk of the plants cultivated in the Mexican area are indigenous, and the native agriculture has retained its character to a remarkable degree under the impact of European domination (31). It must be concluded that the complex of domesticated plants which developed in Middle America constituted a well balanced and stable system of agriculture, which is thereby resistant to extensive establishment of new cultivated plants (with domestic animals, it was quite otherwise). The inertia of cultural patterns is no doubt also involved, but many other areas have proven to possess far less stable systems.

A really comparable list of the pre-Columbian cultivated plants of the Andean region is not available, but would be of great interest. A nearly or quite equal number of cultivated species could probably be enumerated for this area which is noted for its endemic crops.

It has been argued, on competent grounds, that agriculture has had several independent centers of origin in the New World (36, 175). While the origins and present distributions of the cultivated plants cannot alone throw

much light on this, the data presented here in no way conflict with multiple and independent origins for American agriculture. Archaeological evidence seems at present to support this hypothesis and may be expected to add important information in the future (19, 20, 36, 131). Some writers (9) have upheld a very great antiquity for New World agriculture. The information on this is yet fragmentary, but here too, the joint efforts of archaeology and botany are doing much to clarify the picture and indicate a quite respectable age for agriculture in this hemisphere (19, 131).

With attention being focused on the ultimate origins of agriculture, more thought is being given to the manner in which plants first entered cultivation. However, less is being heard of the ingenious savage who decided to return seed or roots to the soil and thereby revolutionized culture overnight (I suspect that early man had an adequate understanding of the seed long before he used this knowledge in agriculture). It seems more probable that the development of agriculture, whatever its pattern, was a gradual process. Some authors (9, 10, 176, 178, 205, 206) have drawn attention to the weedy "camp-follower" element among our cultivated plants, those plants which might be expected to invade camp sites and trash heaps and to be encouraged by man. The hypothesis of a gradual development from such a nearly commensal relationship has much to recommend it. The alliance was probably never purely commensal, but to some degree mutualistic or symbiotic from the beginning, with both members profiting from the association. Instances of semi-cultivation in peripheral areas of North America are described elsewhere (42), and several are known for tropical America. A considerable number of New World cultivated plants are such "weedy" types and many are still to be found on the trash heap; such plants include:

*Amaranthus*, *Capsicum*, *Chenopodium*, *Cucurbita*, *Helianthus*, *Lycopersicon*, *Psidium*, *Salvia* and *Solanum*. Many other plants, such as the cacti and fruit trees, must have been selectively encouraged before agriculture began, just as they are at the present day.

Anderson, in particular, has emphasized the role played by man in the dispersal of useful plants into new areas. This allows hybridization between varieties, and hybridization and introgression between related species. Both of these processes serve at times to promote "weediness" and always to increase the variability of the populations involved, a very important factor in the origin and development of cultivated plants (7, 10, 126). This relationship between man and useful plants doubtless began before agriculture, when man first carried a fruit with him for a while before eating it, thus discarding the seed in a new area.

One cannot discuss the origins of New World agriculture without mentioning the question of trans-Pacific cultural contact. Evidence has been presented concerning several cultivated plants, notably *Gossypium*, *Amaranthus*, *Ipomoea*, *Lagenaria* and *Cocos*, which has been interpreted as indicating early cultural contact between southeast Asia and tropical America (69, 105, 178). This evidence has been discussed at length and opinion is sharply divided (39, 40, 108, 128, 138, 139). This controversy has brought forth, on one extreme, vituperative and dogmatic insistence that no such contact has or could have occurred, and, on the other hand, the wildest flights of fancy, in which all high cultures are derived directly and apparently recently from a single source. I have not cited the extremes on the more fanciful side as they are based largely on non-botanical arguments, if any. They are, however, often associated with other less imaginative views, much to the detriment of the latter. Though the

evidence now available may not prove early cultural contact across the Pacific, it is highly suggestive of such contacts. Our knowledge of cultivated plants and of the earlier cultures is not yet so perfect that we may wrap our minds in the comforting cloak of dogma (nor should it ever be thought so). The evidences should be considered on their own merits; further unbiased studies along these lines cannot fail to be of great value, regardless of the light they may or may not throw on the question of early contacts between the New World and the Old. Whatever the relationship between these two areas, the agriculture of the Americas is, in its broad outlines, distinct both in crops and in techniques from that of the Old World, and particularly so from that of temperate Eurasia.

In conclusion, the geographic origins of most cultivated plants can be stated only in regional terms and can never be very narrowly localized. Of the chronological origins, we can scarcely speak yet even in general terms. The cultivated plants are not easy subjects for comprehensive study, and both botanists and anthropologists have too often neglected them. The outlook, however, is very good. With the use of newer tools (carbon 14 and cytogenetics, for example) and the careful reapplication of the older tools of the many phases of both anthropology and botany, there is every reason to believe that a good culture history can be developed for the most basic and important material culture traits of man, his cultivated plants.

## Summary

The problems and importance of studying cultivated plants are considered, and the criteria used for determining the center of origin of a cultivated plant are reviewed. The cultivated plants of pre-conquest Mexico are enu-

merated and discussed, with special attention given to the botanical literature and the question of geographic origins. The high development of agriculture and the great diversity of habitat in Mexico are favorable for the development of a great variety of cultivated plants. Over eighty species are listed, which may be summarized as to origins as follows:

1. Mexican–Central American region . . . 71 species
   - 1a. Origin not further localized (including maize, beans and cacao) 8 species
   - 1b. Northern Mexico and adjacent areas (sunflower and a pumpkin species) 4 species
   - 1c. Central Mexico (amaranth, chia, *Opuntia* and a race of the avocado) 24 species
   - 1d. Southern Mexico and lowland Central America (yam bean, indigo and papaya) 27 species
   - 1e. Guatemalan highlands (lima bean, chayote and a race of the avocado) 8 species
2. Andean area (cotton and tobacco) . . . . 6 species
3. Brazil-Paraguay region (pineapple) . . . 3 species
4. Uncertain (chile peppers and sweet potato) 8 species

It will be noted that most of the Mexican cultivated plants are native to Middle America, but that some species have been received through diffusion from the Andean area and from lowland South America. The data do not conflict with the hypothesis of several independent centers of origin for New World agriculture. The origin of agriculture as such is discussed and a gradual development through what may be termed a "commensal" pattern is upheld. The botanical evidences concerning trans-Pacific cultural contact are briefly noted. It is felt that real progress is being made in the study of cultivated plants and that cooperation between different disciplines promises continued and valuable progress in the future.

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## EXPLANATION OF THE ILLUSTRATION

PLATE XX. Reproduction of the illustration of *Nicotiana rustica* ("pycielt" or "picietl") and a portion of the discussion of tobacco, from Francisco Hernández: "Rerum Medicarum Novae Hispaniae thesaurus, seu plantarum, animalium, mineralium mexicanorum historia" (Rome 1651) p. 173.

## *De PYCIELT, ſeu Tabaco. Cap. LI.*

PLANTAM, quam Mexicenſes *Pycielt*, ſeu *Yelt* vocant, ab Haitinis appellatur *Tabacus*, à quibus non ad Indos ſolos, ſed & ad Hiſpanos id defluxit nomẽ, eò quod ſuffumigijs admiſceretur, quæ *Tabacos* etiam nuncupare conſueuerunt. à Braſilianis Petum, ab alijs Herba ſacra, à nonnullis Nicotiana dicitur. Non eſt autem vna huius plantæ ſpecies. alij namque tres in hoc antiquo Orbe reperiri affirmant, ac plantam hanc in *Tabacum* maiorem, minorem, & minimum partiuntur. At quia maioris, minorisq; Tabaci differentia puſilla eſt (conſiſtit enim in magnitudine, & longitudine, ac adhærentia foliorum ſine pediculis cauli, vt in maiori obſeruatur, in minori verò folium eſt paulò minus, longo pediculo ramis inhærens, ac florum poſitura; cumq; id ob cauſſas mutationes in plantis efficientes, latius in proœmio explicatas contingere potuerit) non immeritò duæ ſunt tantum ſpecies, quæ obſeruantur in hac noua Hiſpania. quarum alteram *Pycielt*, alteram verò *Quauhyelt* appellant. *Pycielt* ergo herba eſt, folia ferens lata, oblonga, ac Perſonatæ quadantenus ſimilia. caules, quinque pluresvè dodrantes longos, atque hirſutos, inconditos, ſtriatos, & læues. flores Hyoſcyami lutei ſimiles, eisq; decidentibus vaſcula prædicti Hyoſcyami æmula, referta ſemine puſillo, Papaueris minore, ac ex rufo nigricante. radicem breuem, non admodum tenuem, ſed fibratam. *Quauhyelt* verò in magnam aſſurgens altitudinem, Aſſyriam Malum, Limonẽ vocatã, æquat. Caule recto multos emittente ramos, & in eis folia mali Aſſyrij longiora, hirſuta, colore viridi dilutiore, vti tota planta diffuſa. interdumque folia, ſoli, & cœli ratione variantur. quandoque enim cubitalem longitudinem, ac pedalem latitudinem aſſecuta ſine pediculo caulem amplectuntur. nonnumquam verò folia minora, pediculis inhærentia ramis conſpiciuntur. Flores Campanulæ inſtar fert, concauos, ac per extremum ſex, ſeptemuè angulis diſtinctos, candicantes, medio verò purpureſcentes, ordine per ramulorum longitudinem diſpoſitos. quibus ſuccedunt capitula Ocymoidi ſimilia, maiora tamẽ, plena ſemine puſillo ex cine-

Species.

Species I. Pycielt herba reginæ.

Species II. Quauhyelt Nicotiana.

# BOTANICAL MUSEUM LEAFLETS
## HARVARD UNIVERSITY

CAMBRIDGE, MASSACHUSETTS, DECEMBER 31, 1953 VOL. 16, NO. 7


# FREDERICK OLIVER THOMPSON, 1883-1953


BY

ELSO S. BARGHOORN


THE death of Frederick Oliver Thompson on the third of January of this year, brought to an untimely end the life and activities of a man who was justly recognized as one of the country's leading amateur collectors of prehistoric plant life. Certainly in few scientific fields has a nonprofessional worker been so well known to specialists as was Fred Thompson to American paleobotanists. For the careful and accurate documentation of his collections and for the vast amount of material donated to American universities, his record as an amateur paleontologist has few parallels, particularly when it is recognized that his paleontologic interests were confined to only the last two decades of his life.

Fred Thompson (he always preferred to be called "Fred" by his scientific friends, regardless of their age) was born in Des Moines, Iowa, December 29, 1883, the first son of H. DeVere Thompson and Alice Cooper Thompson, who were among the early leaders in the development of Iowa's capitol. After preparation for college at St. Paul's School in Concord, N.H., he was graduated from Harvard College in the Class of 1907. He returned to Cambridge the following autumn for a year's study in the Harvard Law School and then went back to Des Moines to enter the varied business activities

in his native state which occupied most of his later years. In 1912, he married Anna Stroh Cram, of Des Moines, who, with three of their four children, survives him.

While at Harvard, young Fred was quite active in various social clubs, among them the Hasty Pudding Club, the Phoenix Club and the Institute of 1770. During his college years, however, he manifested little of that interest in natural history or science which later became an absorbing interest and intellectual outlet.

Fred Thompson first became interested in fossils in 1930 when he accompanied a friend of his on a collecting trip to the great coal-stripping mines near Coal City, Illinois. Here, the beautifully preserved remains of an ancient Carboniferous flora were being unearthed in great quantities, contained in the curious ironstone nodules which feature the sedimentary rocks of this area. Much time and effort were devoted by Mr. Thompson during the following years to the careful selection of these specimens which were subsequently donated to many colleges and universities. He was somewhat surprised years later to observe one of his own Illinois specimens, properly credited to the collector, on public exhibit in a museum in Mexico City. Harvard's collections of fossil plants were enriched by over ten thousand specimens culled from the spoil piles of the Coal City mines.

In 1938, while on a fossil collecting expedition, Fred discovered a number of the curious calcareous concretions known among paleobotanists as "coal balls." Coal balls, because of their wealth of organically preserved plant tissues, have been one of the major sources of knowledge of the organization and structure of Carboniferous plants since they were first studied in Europe. The interest of paleobotanists in this new discovery was not long in manifesting itself, and during the following seven years Thompson collected literally dozens of tons of the Iowa

coal balls. The majority of these were sent to the Botanical Museum at Harvard, but large numbers were given to other institutions, in particular to Washington University in St. Louis.

Among Fred Thompson's collections of fossil plants, four species, new to the Carboniferous flora, perpetuate his name in the paleontological literature. In addition, he made available for study a large number of other new species of fossil plants, which have added measurably to our knowledge of the structure and evolution of Carboniferous plant life. Indeed, many references to "Collected by Frederick Oliver Thompson" may be seen in paleobotanical publications in the United States since 1938.

Although his field of special interest was paleobotany, noteworthy contributions were also made to invertebrate paleontology; and, to aid studies in this field, a superb collection of modern Floridian sea shells was donated to the State University of Iowa. He also collected many fossil marine invertebrates from the Pennsylvanian strata of central Iowa and especially from the Upper Devonian deposits of the northeastern part of the state. In this work, as so often when in the field, he was accompanied and ably assisted by his wife, Anna. His collections of invertebrate fossils, as in the case of plants, were invariably made available to specialists. Some of the specimens of Iowa's Paleozoic faunas he even sent to places as remote as Canterbury University College in New Zealand, where they have been used by paleontologists for purposes of comparison.

Once, while Fred was splitting fossiliferous nodules near Mazon Creek, Illinois, a boulder of Joliet dolomite, which he was using for an anvil, fractured and a striking trilobite pygidium was exposed. It became the holotype of *Arctinurus thompsoni* Miller and Unklesbay, named in honor of its discoverer. Had it not been for his innate

# Frederick Oliver Thompson

## 1883–1953

*Research Fellow in the Botanical Museum*
*Harvard University*
*1949–1953*

# Plate XXI

modesty regarding his finds, several species of fossil cephalopods would also have been named for him. Since his death, however, a fine specimen from the Ordovician of Baffin Island will honor him in this manner.

It should also be noted, in the realm of invertebrate paleontology, that at least a half dozen of the Special Papers and two of the forthcoming Memoirs of the Geological Society of America carry acknowledgment to Frederick Thompson for financial assistance during their preparation. The same is true for a paleontological monograph recently published by the Museé du Congo Belge and for more than a dozen papers in the Journal of Paleontology.

In addition to his indefatigable collecting, both of fossil plants and of invertebrates, Fred was invariably fomenting and fostering research projects in paleobotany and other aspects of paleontology. His voluminous correspondence and lively and stimulating communications with workers in widely scattered institutions attest to his restless striving to make paleontology a more dynamic field of intellectual interest and activity. In many ways he was more successful in these efforts than were his professional (and scientific) colleagues.

Although the writer personally knew Fred Thompson only during the last six years of his life, the memory of the man will stand, not only on his scientific contributions, but on his unforgettable personality as well. His interest in people partook both of their foibles and their serious endeavors and he was always ready with an anecdote in either vein. This made him a delightful companion in the field and eased the disappointments so often experienced in unsuccessful collecting in unfamiliar localities. In pursuit of new finds, despite failing health in his later years, Fred's energy and cheerful persistence in

the field were a source of inspiration to younger companions.

Perhaps, above all, for those who knew Frederick Thompson as an amateur paleontologist, he will be remembered most clearly for his selflessness, his generosity and his intense devotion to his chosen field of scientific interest.

## *Species named in honor of Frederick O. Thompson*

Arctinurus thompsoni *Miller & Unklesbay* in Journ. Paleont. 18 (1944) 364.

Macrostachya Thompsonii *Darrah* in Bot. Mus. Leafl. Harvard Univ. 4 (1936) 53.

Medullosa Thompsonii *Andrews* in Ann. Mo. Bot. Gard. 32 (1945) 324.

Mesoxylon Thompsonii *Traverse* in Am. Journ. Bot. 37 (1950) 324.

Sphenostrobus Thompsonii *Levittan & Barghoorn* in Am. Journ. Bot. 35 (1948) 353.

# BOTANICAL MUSEUM LEAFLETS
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# PLANTAE AUSTRO-AMERICANAE IX
## PLANTARUM NOVARUM VEL NOTABILIUM NOTAE DIVERSAE


BY

RICHARD EVANS SCHULTES[1]


CONTINUED studies of recent collections from northwestern South America, chiefly from Colombia, have disclosed a number of plants which are, for one reason or another, of importance to our growing understanding of the flora of this critical part of the New World tropics. Most of the plants herein discussed are from Amazonian Colombia.


I acknowledge with thanks the collaboration of Dr. Lyman B. Smith, of the Smithsonian Institution, who is responsible for the work on the *Bromeliaceae*, and of Dr. Alicia Lourteig, Guggenheim Fellow in Botany at the Gray Herbarium of Harvard University, who has contributed the section on *Cuphea*.


### ARACEAE

**Anthurium atropurpureum** *Schultes & Maguire ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 16 (1953) 60.

Further studies on the aroids of Amazonian Colombia have made it seem advisable to publish a drawing of *An-*


[1]Botanist, Division of Rubber Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Research Fellow, Botanical Museum of Harvard University.

*thurium atropurpureum* (Pl. XXII). Later studies may indicate that this species represents a very important complex on the Cretaceous quartzitic hills and savannahs of the Vaupés and Amazonas.

**Anthurium atropurpureum** *Schultes & Maguire* var. **apertum** *Schultes var. nov.*

Haec varietas ab *Anthurio atropurpureo* nervis secundariis arcuatis apertis vel non confluentibus spatha spadiceque majoribus differt.

It might at first seem that the venation character upon which this newly described variety is based is trivial. Notwithstanding its rather unobtrusive nature on superficial examination, I have found that it is stable. Having no other morphological characters of importance to differentiate it as a species, this concept is probably best treated as a variety of *Anthurium atropurpureum*.

The secondary veins of *Anthurium atropurpureum*, as can be seen in the figure published herewith, are arcuate and run together near the margin of the leaf-blades to form a continuous and stout nerve parallel to the margin. In the new varietal concept here described, the secondary veins are also arcuate, but they are not confluent and, consequently, do not form a continuous nerve along each margin. The varietal epithet has reference to the open appearance of the veins in contrast to the closed appearance which the confluent veins of the species exhibit.

Like *Anthurium atropurpureum*, this new variety is an inhabitant of the curious xerophytic islands of savannah or scrubby vegetation that are found scattered here and there in the Colombian Amazonia. *Anthurium atropurpureum* var. *apertum* is probably much more abundant and perhaps more widespread than is *A. atropurpureum* itself.

Colombia: Comisarías del Amazonas-Vaupés, Río Apaporis, Raudal de Jirijirimo. Extensive white-sand savannah or caatinga on right

bank. "Spike purple. Leaves stiff. In sterile white sand." March 1951, *Richard Evans Schultes 12094* (TYPE in Herb. Gray).—Same locality. August 12, 1951, *Richard Evans Schultes & Isidoro Cabrera 13517*.—Comisaría del Vaupés, Río Vaupés, Raudal de Yuruparí (± 350 kts. arriba de Mitú). Alt. 220 m. "Espata verdosa; espádice amarillo-violáceo." September 24, 1939, *J. Cuatrecasas 6963*.

**Anthurium crassinervium** (*Jacq.*) *Schott* Melet. 1 (1832) 22.

*Anthurium crassinervium* appears to be rather widespread in northern South America, but in the northwest Amazon basin it is confined to the granitic, pre-Cambrian, dome-shaped mountains, where it occurs often in great abundance under conditions of extreme xerophytism. The collection *Cuatrecasas 6885* establishes its occurrence in the Colombian Amazonia.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cerro de Mitú. Alt. 380 m. "Espadice pardo-violáceo." September 17, 1939, *J. Cuatrecasas 6885*.

VENEZUELA: Territorio del Amazonas, Río Negro, Piedra del Cocuí. "Terrestrial." December 22–23, 1947, *Richard Evans Schultes & Francisco López 9423*.

**Anthurium gracile** (*Rudge*) *Engler* in Bot. Jahrb. 25 (1898) 370.

A widespread plant of the rain tropics of South America, *Anthurium gracile* has apparently not hitherto been reported from eastern Colombia.

COLOMBIA: Intendencia del Meta, Sabanas de San Juan de Arama, margen izquierda del Río Güejar, alrededores del aterrizaje "Los Micos." Alt. ca. 500 m. "Epífita. Espata purpúreo-grisácea." January 22, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1268*.

**Anthurium Idroboanum** *R. E. Schultes sp. nov.*

Herba terrestris, usque ad $2\frac{1}{2}$ pedes alta, in coloniis in silvis densis pluviosisque crescens. Caudiculus magnopere abbreviatus, robustus, internodiis brevissimis. Folia rigidissime erecta, valde coriacea, supra atroviridia, sub-

tus pallide viridia, cum petiolis strictis crassioribus sulcate subtetragonisque, basi latiuscule dilatatis, usque ad 31 cm. longis, 8–10 mm. in diametro; angulis praecipue apicem versus inconspicue alatis; lamina adulta glabra, supra atroviridis, subtus pallidior, cordato-ovata, apice rotundato-obtusa, leviter marginata, lobis posticis circiter 10 cm. longis, 2–3 cm. latis, rotundatis, sinu angusto acuto sejunctis, nervo centrali robusto recto (siccitate substramineo) usque ad apicem penetrante, supra leviter sed subtus valde elevato, nervis secundariis vel lateralibus arcuatis, non confluentibus, e basi nascentibus utrinque tribus centralibus similibus, transversis paucis paullo tenuioribus conjunctis. Inflorescentia erecta, pedunculo aliquid carnosulo, usque ad 60 cm. longo, 5–8 mm. in diametro. Spatha late lanceolata, glaberrima, utrinque flavo-viridis, basi cordato-amplexicaulis, apice acuta, usque ad 9 cm. longa, inferne 2 cm. lata, vivo non recurva. Spadix erectus, caudiformis vel cylindricus, apice plusminusve truncatus, apparenter estipitatus, 7–10 cm. longus, atropurpureus.

*Anthurium Idroboanum*, belonging to Engler's section *Cardiolonchium*, seems to resemble most closely *A. magnificum* Linden, native of the eastern cordillera of Colombia, a species which has been important in hybridization for horticultural work in the genus. The former may be distinguished from the latter at once by differences in the size and venation of the leaves, by having an estipitate spadix which is only half as long and by having much shorter and more membranaceous, yellowish green spathes. The leaf of the newly described species is also far more coriaceous than that of *Anthurium magnificum*, and the plant seems to be humbler.

The base of the leaf of *Idrobo & Schultes 957* is far more deeply cordate than in the type collection, but all other essential characters exhibit an unusual stability in

the three collections which are at present available.

COLOMBIA: Intendencia del Meta, Cordillera La Macarena (extremo nordeste), Macizo Renjifo, cumbre y alrededores. Alt. 1300–1900 m. "En colonias. Sobre capa de hojas secas. Espádice purpúreo." January 6–20, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1162* (TYPE in Herb. Gray).—Same locality and date. "Terrestrial. Spathe green, bent back. Leaf discolourous, very dark green above, lucid above, pale green and punctate beneath. Basic colour of spadix reddish brown." *Jesús M. Idrobo & Richard Evans Schultes 957*.—Intendencia del Meta, Sierra de La Macarena, Central Mountains, North Ridge. Alt. 1400 m. "Dense humid forest. Terrestrial; leaves coriaceous. Spathe green, tinged with red; spike brown." December 25, 1949, *W. R. Philipson & J. M. Idrobo 1926*.

**Anthurium macarenense** *R. E. Schultes & Idrobo sp. nov.*

*Anthurio cabrerensi* proxima sed principaliter lamina membranacea (non coriacea), apice abrupte et longe attenuata (non acuta), spatha atrosanguinea venis viridibus elongato-lanceolata spadici subaequali (non spatha cuprea ovato-lanceolata spadicis longitudinis $\frac{2}{3}$ aequanti) differt. *Anthurium macarenense* would seem to be very closely allied to *A. cabrerense* Engl. from the Departamento del Tolima in Colombia, which is described and well illustrated in Engler Pflanzenreich IV. 23B (Heft 21) (1905) 208.

The former species differs from the latter primarily in having a more delicate leaf-blade which is abruptly and attenuately tipped, and in having a spathe which differs in size, shape and color.

COLOMBIA: Intendencia del Meta, Cordillera La Macarena (extremo nordeste), Macizo Renjifo, cumbre y alrededores. Alt. 1300–1900 m. "Spathe deep red or maroon both sides with veins greenish. Epiphyte. Fruits pink. Peduncle and petioles red. Spathe arcuate." January 6–20, 1951, *Richard Evans Schultes & Jesús M. Idrobo 954* (TYPE in U. S. Nat. Herb. No. 2029669).—Intendencia del Meta, Sierra La Macarena, selva densa entre los Ríos Güejar y Sansa. Sobre la mesa nordeste. Alt. 500–1,000 m. August 29, 1950, *J. M. Idrobo 527*.

**Anthurium macrocephalum** *R. E. Schultes sp. nov.*

Herba terrestris, ut videtur usque ad 2½ vel 3 pedes alta, in silvis umbrosis humidisque crescens. Caudiculus probabiliter abbreviatus. Folia rigide erecta, coriacea, supra vivo apparenter atroviridia, subtus pallidiora, cum petiolis crassis, lateraliter compressis, sulcatis, quam lamina longioribus, 55 cm. longis vel longioribus, 10 mm. in diametro vel vivo majoribus; lamina adulta glabra, utrinque minutissime (subtus densius) nigropuncticulata, ovata, apice rotundata, basi breviter attenuata, margine aliquid inerassata, plusminusve 44 cm. longa, 35 cm. lata, cum costa sex-nervia, nervis lateralibus primariis intimis in apicem exeuntibus, duobus extimis in infima media parte margine crassiore approximatis et in eo evanescentibus, secundariis parallelis, tenuibus inter se 1.5–2 cm. distantibus, tertiis pluribus tenuissimis. Inflorescentiae usque ad 62 cm. altae vel altiores, erectae sed apparenter spadice nutanti, pedunculis petiolis similibus, usque ad 12 cm. in diametro. Spadix cylindricus, apice rotundato-obtusus, 20–22 cm. longus, siccitate 3.5 cm. in diametro, estipitatus, viridis. Spatha coriacea, late lanceolata, apice acuta, 8–9 cm. longa, 2–2.4 cm. lata, glaberrima, viridis. Baccae oblongae, tetragonae, in stylum prismaticum productae.

*Anthurium macrocephalum* belongs to Engler's section *Digitinervium* and seems to be closely related to *A. pangoanum* Sod. of Ecuador. The former can be distinguished from the latter principally by having leaves which, while shorter, are wider, giving them a truly ovate shape; by having a much longer petiole; by having a much thicker spadix which is green, not rose-colored; and by having a much longer and wider spathe. *Anthurium pangoanum* is described as being "nigropunctata" on both surfaces of the leaf, but in *A. macrocephalum* the

upper surface, although extremely remotely beset with minute black dots, cannot be compared with the lower surface, which is rather densely ornamented with these glandular (?) structures.

COLOMBIA: Departamento del Cauca, El Tambo, Cordillera Occidental, vertiente oriental, La Paz y alrededores, Las Juntas. Alt. 1400–1700 m. "En riachuelo, parte sombrosa. Espata verde, espádice verde." August 29, 1949, *J. M. Idrobo 280* (TYPE in U.S. Nat. Herb. No. 2029344).

**Anthurium nemoricola** *Schultes & Maguire ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 16 (1953) 61.

It has been considered advisable to publish the accompanying drawing (Pl. XXII) of this curious little xerophytic species of *Anthurium*.

**Anthurium oblongo-cordatum** *Engler* in Pflanzenr. IV, 23B (1905) 110.

This species was first described from the Quindio region of Colombia. The collection cited below, in spite of slight differences from the type, would seem to be easily accommodated in *Anthurium oblongo-cordatum*.

COLOMBIA: Departamento del Cauca, Cordillera Occidental, vertiente oriental. Cuchilla del Tambo. Alt. 1750 m. August 1949, *Jesús M. Idrobo & Alvaro Fernández 44*.

**Anthurium panduratum** *Martius ex Schott* in Oestr. Bot. Wochenbl. (1855) 273.

*Anthurium panduratum* was described from material collected by Martius on the "Japurá" (Río Caquetá), probably in Colombian territory. The collections cited below indicate that the concept is relatively widely distributed in Amazonian Colombia.

COLOMBIA: Comisaría del Vaupés, San José del Guaviare. November 12, 1939, *J. Cuatrecasas 7444*.—Comisaría del Amazonas, Río Loretoyacu, September 1945, *Richard Evans Schultes 6071*.—Comisaría del Amazonas, Río Loretoyacu, October 21, 1946, *Richard Evans Schultes & George Black 8549*.—Comisaría del Amazonas, Río Boiauassú, October 27, 1946, *Richard Evans Schultes & George Black 8606*.

**Anthurium pentaphyllum** (*Aubl.*) *G. Don* in Sweet Hort. Brit. ed. 3 (1834) 633.

Widespread in tropical South America, *Anthurium pentaphyllum* has hitherto not been recorded from Amazonian Colombia.

Colombia: Comisarías del Amazonas-Vaupés, Río Apaporis, entre el Río Pacoa y el Río Kananarí. Soratama. Alt. ca. 250 m. "Climbing epiphyte. Spathe greenish, yellow near tip. Spadix green-grey, reflexed." August 27, 1951, *Richard Evans Schultes & Isidoro Cabrera 13786.*

**Anthurium popayanense** *Engler* in Bot. Jahrb. 6 (1885) 274.

*Anthurium popayanense* has hitherto been known only from the region around Popayán in Colombia.

Colombia: Intendencia del Chocó, Corcovada Region, upper Río San Juan. Ridge along Yeracüí Valley. Alt. 200–275 m. Dense forest. "On tree. Spathe green. Spadix pinkish yellow." April 24–25, 1939, *E. P. Killip 35315.*

**Anthurium reticulatum** *Bentham* Pl. Hartweg. (1846) 255.

*Anthurium reticulatum* has previously been known from the regions near Cali and Popayán in Colombia.

Colombia: Intendencia del Chocó, dense forest south of Río Condoto, between Quebrada Guarapo and Mandinga. Alt. 120–180 m. "Terrestrial. Spathe green. Spadix pink." April 22–28, 1939, *E. P. Killip 35439.*

**Anthurium scolopendrinum** (*Ham.*) *Kunth* Enum. Pl. 3 (1841) 68.

Notwithstanding the fact that this species is rather widespread in tropical South America, it has apparently not hitherto been reported from eastern Colombia.

Colombia: Intendencia del Meta, Sabanas de San Juan de Arama, margen izquierda del Río Güejar, alrededores del aterrizaje "Los Micos." Alt. ca. 500 m. "Espata roja. Espádice rojo." January 22, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1203.*

**Paepalanthus Moldenkeanus** *R. E. Schultes sp. nov.*

Planta frutescens, robusta, sublignosa, breviter caulescens. Folia prope rami simplicis apicem rosulate disposita, firmissime chartacea, plana, attenuato-linearia, 18–21 cm. longa, basi 1.5–2.3 cm. (parte centrali 1–1.5 cm.) lata, basi dense longeque albo-pilosa, infra medium margine (et raro in lamina) maxime sparsissime breviterque setosa, demum utrinque glabra nitidaque. Caulis florifer erectus, robustior, sublignosus, usque ad 1.80 m. altus, 1–1.5 cm. in diametro, bracteis multis foliaceis, chartaceis, lanceolato-triangularibus, usque ad 13.5 cm. longis, basi 2.4 cm. latis, apicem versus minoribus, margine remotissime albo-ciliatis, utrinque glabris nitidisque, spiraliter obtectus. Pedunculi plusminusve centum quadraginta, filiformes, 30–35 cm. longi, 1.5–2 mm. in diametro, glabri, obscure bicostati, conspicue contorti, vaginis gracillimis, cylindricis, chartaceis, stramineis, apice bifidis, basi dense albo-pilosis, contortis, 4.5 cm. longis. Capitula perfecte globosa, luteo-albida, 10–12 mm. in diametro. Bracteolae stramineae, triangulares, circiter 2 mm. longae, 1–1.5 mm. latae. Flores staminiferi basi dense longeque albo-barbati, sepalis hyalinis, oblongis, apice acutis et barbellatis, 3 mm. longis, 1 mm. latis, petalis in tubum infundibuliformem, 3.5–4 mm. longum connatis, staminibus circiter 1 mm. longis. Flores pistillati basi dense longeque albo-barbati, sepalis hyalinis, late spathulatis, 4.5 mm. longis, 2–2.5 mm. latis, petalis similibus sed paulo majoribus, apice barbellatis, stigmatibus 2 mm. longis, ovario elongato-ovoideo, 2 mm. longo, 1 mm. in diametro, glabro sed basi densissime albo-barbato.

*Paepalanthus Moldenkeanus* is set apart from all other known species of the genus from Colombia and northern

South America by its unusual size. It is a robust plant that normally reaches a height of five and a half or six feet.

This extraordinary plant inhabits the immense sandstone savannahs to the north of the Colombian part of the Río Vaupés above Mitú. It has been collected at Yapobodá at the headwaters of the Río Kuduyarí and at Kañendá on the Río Kubiyú. An aeroplane reconnaissance has shown that these two savannahs are continuous. I have seen this plant, but was unable to collect it, on the great savannahs of Goo-rán-hoo-da on the Río Karurú in the upper Vaupés. The Karurú savannahs may possibly be continuous with Kañendá and Yapobodá. *Paepalanthus Moldenkeanus* undoubtedly represents another of the curious endemic plants which have turned up during our investigation of these ancient quartzitic savannah formations in the Vaupés.

Growing in close proximity to *Vellozia lithophila*, *Bombax coriaceum*, *Hevea nitida* var. *toxicodendroides*, *Leitgebia colombiana* and *Styrax rigidifolius* forma *yapobodensis*,[1] *Paepalanthus Moldenkeanus* is admirably adapted to the extreme conditions of xerophytism which obtain on these savannahs. It occurs in isolated colonies of from ten to fifty individuals in slight depressions or swales on the usually flat savannah. These swales are moist and highly acidic and are repositories of very interesting grasses and sedges, as well as xyridaceous, lentibulariaceous and eriocaulaceous species. There are a number of other species of *Paepalanthus* in the same localities, but all are diminutive plants.

It is appropriate that I dedicate this majestic new species to my friend, Dr. Harold N. Moldenke, in recognition of his extensive researches in the family *Eriocaulaceae*.

[1] Steyermark (in Fieldiana 28 (1953) 492) considers *Styrax yapobodensis* (Idrobo & R. E. Schultes) Steyerm. to be a distinct species.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí (tributary of Río Vaupés), Yapobodá. Quartzite savannah near headwaters. Alt. about 900–1000 feet. General location: Lat. 1°20′ N, Long. 70°30′ W. "From 4 to 6 feet tall. Flowers white." October 4–5, 1951, *Richard Evans Schultes & Isidoro Cabrera 14351* (TYPE in Herb. Gray).—Comisaría del Vaupés, Río Kuduyarí (tributary of Río Vaupés), Yapobodá, quartzite savannah near headwaters. Alt. about 900–1000 ft. General location: Lat. 1°20′ N, Long. 70°30′ W. "Up to 6 feet tall. Flowers yellow-white." October 5–6, 1951, *Richard Evans Schultes & Isidoro Cabrera 14265*.—Comisaría del Vaupés, Río Kubiyú (tributary of Río Vaupés), Cerro Kañendá, savannahs about 15 miles upstream from mouth. Quartzite base. Alt. about 800–900 feet. General location: Lat. 1°0′ N, Long. 70°15′ W. November 10, 1952, *Richard Evans Schultes & Isidoro Cabrera 18385*.—Comisaría del Vaupés, Río Kubiyú (tributary of Río Vaupés), Cerro Kañendá, savannahs about 15 miles upstream from mouth. Quartzite base. Altitude about 800–900 feet. General location: Lat. 1°0′ N, Long. 70°15′ W. "Four feet tall. Flowers yellow-white." May 5, 1953, *Richard Evans Schultes & Isidoro Cabrera 19239*.—Comisaría del Vaupés, Río Kuduyarí (tributary of Río Vaupés) Yapobodá. Quartzite savannah near headwaters. Alt. about 900–1,000 feet. "Four feet tall. Common in swales." April 1953, *Richard Evans Schultes & Isidoro Cabrera 19975*.—Comisaría del Vaupés, Río Kubiyú, Cerro Kañandá. Alt. más o menos 380 m. "Dos metros alto, erecto; flores blancas." November 2–4, 1952, *Hernando García-Barriga 15088*.

## THURNIACEAE

**Thurnia sphaerocephala** (*Rudge*) *Hooker filius* in Hooker Icon. Pl. (1883) t. 1407.

The collections *Schultes & Cabrera 17568* and *19853* establish for the first time the occurrence in Colombia of the monogeneric family *Thurniaceae*, allied to the *Juncaceae* and the *Rapateaceae*.

The genus *Thurnia* comprises two species. *Thurnia Jenmani* occurs in British Guiana, where the type was found "thickly choking the Potaro river above and below the Kaieteur falls." The range of *Thurnia sphaerocephala* is greater, including British Guiana and in scattered localities in the Brazilian Amazonia south to the Xingú and west to the Solimões. The range extension

herewith reported to Amazonian Colombia greatly amplifies the known distribution of this rare plant.

In the small creeks and rills forming in the headwaters of the Río Piraparaná, *Thurnia sphaerocephala* grows in extraordinary abundance in the shallow waters, together with a species of *Pontederia*. It often grows so thickly that it impedes canoe travel completely. This habitat is unusual, for the type and numerous later collections of the species from British Guiana report the habitat as "savannahs."

I have seen *Thurnia sphaerocephala*, but did not collect it, in Caño Paca, one of the rills forming the headwaters of the Río Papurí, and in the very sources of the Río Dji. Both the Papurí and the Dji, rising in an area near the headwaters of the Río Piraparaná, are affluents of the Río Vaupés.

The westernmost locality of the family is that of *Schultes & Cabrera 19853*, in the headwaters of the Caño Churruco, a brook of clear water, draining a quartzitic area. It is not abundant, however.

COLOMBIA: Comisarías del Amazonas-Vaupés, Río Apaporis, Soratama (above mouth of Río Kananarí) and vicinity, Caño Churruco. Alt. about 900 feet. General location: Lat. 0°5′ N, Long. 70°40′ W. "In water." January 1952, *Richard Evans Schultes & Isidoro Cabrera 19583*. —Comisaría del Vaupés, Río Piraparaná (tributary of Río Apaporis), Caño Paca. General location between Lat. 0°15′ S, Long. 70°30′ W and Lat. 0°25′ N, Long. 70°30′ W. September 19, 1952, *Richard Evans Schultes & Isidoro Cabrera 17568*.

## RAPATEACEAE

**Schoenocephalium Martianum** *Seubert* in Martius Fl. Bras. 3, pt. 1 (1847) 130, t. 19.

The curious and beautiful genus *Schoenocephalium* was based on material collected at Araracuara on the Río Caquetá, Colombia, by Martius in 1820. Two species were described: *Schoenocephalium Martianum* and *S. arthrophyllum*.

In 1944, I collected for a week at Araracuara, Martius' westernmost station in the Amazon and the type locality for a large number of endemics, some of which, like *Schoenocephalium Martianum*, had never subsequently been found. I found this species to be one of the dominant plants on the high, flat savannah of white sand at the picturesque chasm called "Angostura." Unfortunately, my collections of the plant from that trip were lost in an aeroplane accident.

In December 1951, Dr. García-Barriga and I spent an afternoon at Araracuara whilst emergency repairs were being made on our aeroplane. We were able to make an interesting collection of about fifty numbers which will be reported later. Amongst these was an ample topotypical collection of *Schoenocephalium Martianum*.

As we stepped off the aeroplane at the prison colony at Araracuara, we saw, near the shore, a small portable altar set up by visiting clerics for Christmas. This altar was extravagantly decorated with the beautiful pink-red wax-like inflorescences of *Schoenocephalium Martianum*, one of the rarest plants of the world!

A number of months later, we were astonished to find a florist shop in Bogotá with a window full of *Schoenocephalium Martianum* heads. It appears that a lucrative commerce has grown up. Every time a Colombian government flight goes to the prison colony at Araracuara to relieve the guards, the returning police bring back enormous bundles of the long-lasting heads for sale to florists in the nation's capital under the common name *estrellitas del sur* ("little stars from the south"). The retail price in Bogotá in January 1953 was three pesos a dozen (approximately $1.20 in U.S. money).

I collected seed of *Schoenocephalium Martianum* and sent it to the Bureau of Plant Industry of the United States Department of Agriculture and the Royal Botanic

Gardens at Kew, in the hope that this precious little gem might be introduced to horticulture, but both attempts were failures.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, Araracuara. Sabana de Angostura. Alt. 400 m. Suelo pedregoso, con arena blanca. "Yerba erecta. Inflorescencia 0.48 m. Flores blancas en el ápice, en la base rojas." December 21, 1951, *H. García-Barriga & Richard Evans Schultes 14172.*

## BROMELIACEAE

(Contributed by Lyman B. Smith)

**Pitcairnia macarenensis** *L. B. Smith sp. nov.*

*Pitcairniae pungenti* HBK. in systema Mezii proxima, sed foliis majoribus integerrimis petiolatis, vaginis foliorum atro-castaneis, laminis foliorum lineari-lanceolatis canaliculatis differt.

Stemless, the flowering shoot 55 cm. high; leaves entire, dimorphic, some reduced to broadly ovate apiculate dark castaneous sheaths, others over 1 meter long with slender elongate petioles, the blades linear-lanceolate with a strong median channel, filiform-acuminate, 30–35 mm. wide, flat, glabrous; scape erect, slender, sparsely white-flocculose; scape-bracts erect, imbricate, lanceolate, acuminate, sparsely pale-lepidote; inflorescence simple, dense, 7–9 cm. long, white-flocculose except for the petals; floral bracts narrowly triangular, much exceeding the pedicels, pale green; pedicels slender, 8 mm. long; flowers suberect; sepals lance-oblong, acute, 28 mm. long, the posterior ones strongly carinate; petals slightly zygomorphic, linear, obtuse, 45 mm. long, red, bearing a large oblong truncate scale at base; stamens included; ovary three-fifths superior; ovules caudate.

COLOMBIA: Intendencia del Meta, northeastern end of Cordillera La Macarena, slopes of Cuchillo Palmitas, Macizo Renjifo. Alt. 1,500 m. "On rocks." March 1951, *Richard Evans Schultes 12126* (TYPE in U.S. Nat. Herb. No. 2048070).

**Pitcairnia patentiflora** *L. B. Smith* in Contrib. Gray Herb. 127 (1939) 18, t. 1, fig. 4.

This species, one of those with a distribution on the Guiana-Venezuela land-mass, has been reported from Colombia as far west as Cerro Chiribiquete (in Bot. Mus. Leafl. Harvard Univ. 12 (1946) 121). The collection cited below is intermediate between the type locality, Cerro Duida, and Chiribiquete.

COLOMBIA: Comisaría del Vaupés, Río Naquieni, Cerro Monachí. "Flowers and axis of inflorescence red." June 1948, *Richard Evans Schultes & Francisco López 10082*.

**Brocchinia hechtioides** *Mez* in Fedde Rep. Spec. Nov. 12 (1913) 414.

The specimen cited below is the first record for Colombia of a species previously known from Mount Roraima and the Amazonas Territory of Venezuela.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. Alt. 250 m. above the river, 700 m. above sea-level. Crest of the cerro in rocky sandstone soil. November 29–30, 1951, *H. García-Barriga 13796*.

**Navia caulescens** *Martius ex Schultes filius* var. **minor** *Schultes & Schultes filius* in Roem. & Schult. Syst. 7 (1830) 1195.

The species and its variety *minor* were described together and, in default of any designation to that effect, the inference is that the second locality mentioned, Araracuara, applies to the variety. The recent collections cited below would tend to confirm this view and also to show a large extension of the range of the variety. There is a considerable variation in the dimensions of the leaves but no notable difference in the flowers.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, Araracuara: Sabana de La Angostura. Alt. ca. 400 m. December 21, 1951, *H. García-Barriga & Richard Evans Schultes 14171*.—Comisaría del Vaupés, Río Kananarí, Cerro Isibukurí. November 29–30, 1951, *H.*

*García-Barriga 13798, 13816.*—Comisaría del Vaupés, Río Karurú, Savannah of Goo-rán-hoo-da. Alt. ca. 240 m. "In large mats on sandstone rocks exposed to sun." April 15–16, 1953, *Richard Evans Schultes & Isidoro Cabrera 19168.*

**Navia Garcia-Barrigae** *L. B. Smith sp. nov.*

Ab omnibus speciebus adhuc descriptis inflorescentia magna, laxe ampleque tripinnatim paniculata differt.

Stemless (! García-Barriga), the flowering plant over 8 dm. high; leaves rosulate, the sheaths unknown, the blade linear, acuminate, 22 cm. long, 8 mm. wide, very laxly serrate with minute curved ascending spines, covered on both sides with white appressed scales, roseate for 2 cm. at base; scape unknown; inflorescence nearly 8 dm. long, amply and laxly tripinnate, glabrous, red-brown when dry; primary bracts narrowly triangular, 16 mm. long, much shorter than the naked flattened sterile bases of the branches, entire, nerved; branches spreading, to 25 cm. long, their axes straight and very slender; racemes to 9 cm. long including the short sterile base, subdensely many-flowered; floral bracts broadly ovate, acuminate, 2 mm. long, thin; flowers obscurely pedicellate, spreading; sepals homomorphic, subtriangular, obtuse, 2 mm. long, ecarinate; petals 3.5 mm. long, white; ovary superior; ovules unappendaged.

Colombia: Comisaría del Amazonas, Río Caquetá, Araracuara, Sabana de La Angostura. In white sand among rocks. December 21, 1951, *H. García-Barriga & Richard Evans Schultes 14137* (Type in U.S. Nat. Herb. No. 2057246).

**Navia heliophila** *L. B. Smith sp. nov.*

Herba plusminusve caulescens sed foliis vivis apice solum praedita; foliis multis, rosulatis, pro genere amplis, dense serrulatis, glabris; scapo brevissimo; inflorescentia densissime paniculata, globosa; sepalis oblongo-lanceolatis, minimis.

Somewhat caulescent; most of the stem covered with

decayed leaf-bases; living leaves many in a spreading rosette at the apex of the stem, the sheaths completely covered, the blades linear, acute, pungent, 25 cm. long, 17 mm. wide, flat, densely serrulate, glabrous; scape very short; inflorescence very densely paniculate, globose, 25 mm. in diameter; primary bracts lance-triangular, pungent, serrate, shorter than the globose short-stipitate spikes; floral bracts ovate, acute, slightly but consistently shorter than the sepals, ferruginous-flocculose at base; pedicels short and inconspicuous; sepals lance-oblong, acute, 6 mm. long, the posterior ones sharply carinate and connate for 2 mm.; petals white (! Schultes), the blades spreading, narrowly elliptic.

In habit, *Navia heliophila* closely resembles *N. angustifolia* (Bak.) Mez of Guiana and *N. xyridiflora* L. B. Smith of Venezuela, but it differs from the former in its much smaller flowers and from the latter in its sharply acute sepals.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Raudal de Jirijirimo. "On exposed ledge in savannah and caatinga." March 1951, *Richard Evans Schultes 12085* (TYPE in U.S. Nat. Herb. No. 2048050). —Same locality. November 25–26, 1951, *H. García-Barriga 13712, 13735*.

**Navia Lopezii** *L. B. Smith ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 15 (1951) 40.

It is now possible to publish the plate (XXVIII) prepared to illustrate this species.

**Navia Lopezii** *L. B. Smith ex Schultes* var. **colombiana** *L. B. Smith var. nov.*

A *Navia Lopezii* inflorescentiae bracteis exterioribus quam sepalis brevioribus, petalis albis differt.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. Alt. 250–700 m. "On cliff in shade. Bracts of flowers purple outside, pinkish or yellowish inside. Flowers white. Leaves almost membranaceous." August 4, 1951, *Richard Evans Schultes & Isidoro Cabrera 13342* (TYPE in U.S. Nat. Herb. No. 2120933).

**Navia myriantha** *L. B. Smith ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 15 (1951) 41.

Herewith is a drawing (Pl. XXVIII) which inadvertently was not published with the original description.

**Navia reflexa** *L. B. Smith sp. nov.*

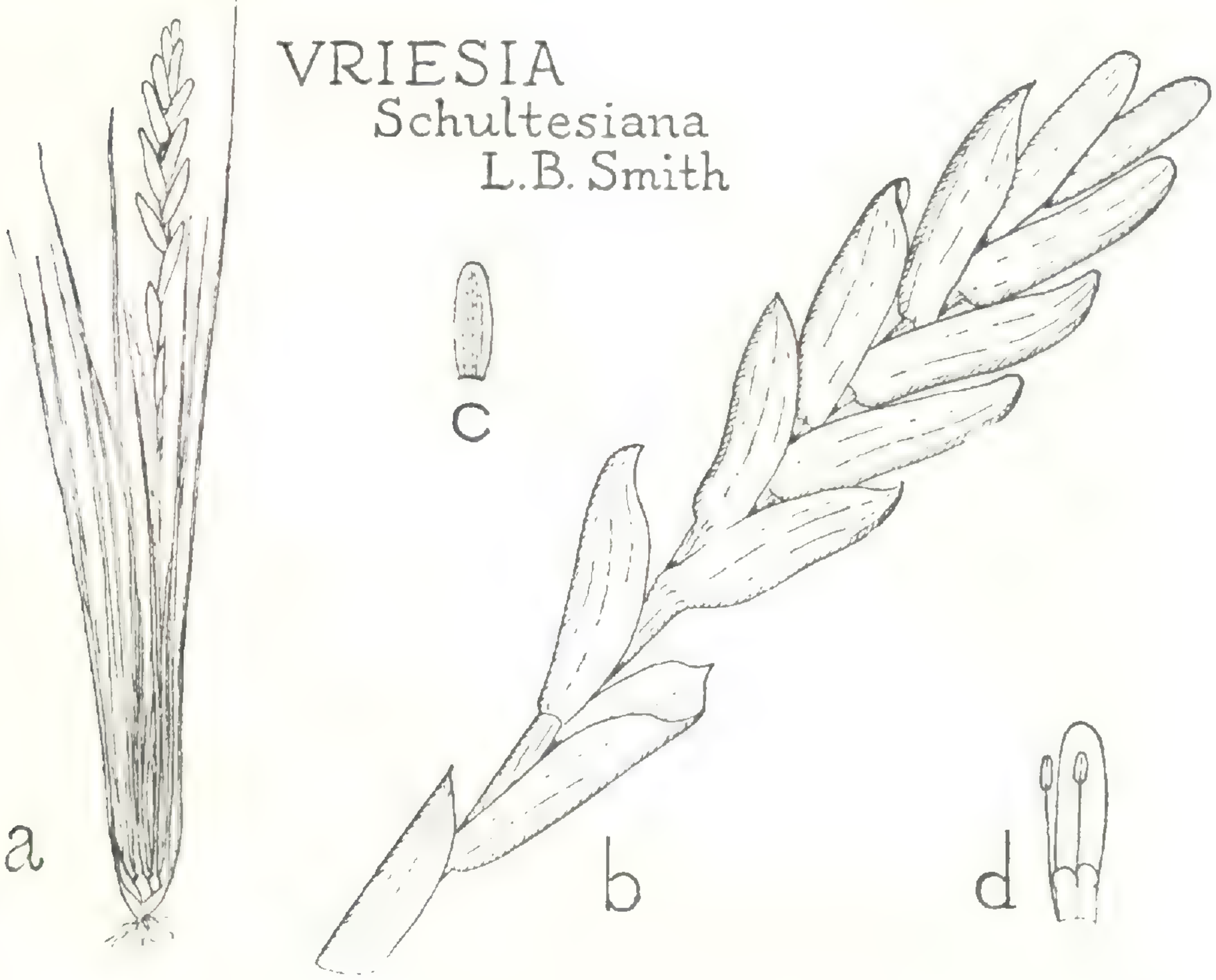
A *Navia Garcia-Barrigae* L. B. Smith, supra descripta, omnibus partibus multo majoribus, ramulis ultimis pendulis, floribus reflexis, ovario $\frac{1}{3}$ infero differt.

Terrestrial, the flowering plant over 3 m. high; leaves (only one known) 9 dm. long, the sheath subquadrate, 5 cm. long, barely wider than the blade, white except for the lustrous brown apex, entire, nearly glabrous, the blade linear with a long entire acuminate pungent apex, 5 cm. wide, flat, closely sulcate, laxly serrate with dark ascending spines 1.5 mm. long, covered above with a very fine white membrane of coalesced scales, glabrous beneath; scape erect, over 14 mm. in diameter, glabrous (at least in age); scape-bracts erect, foliaceous but much reduced, much exceeding the internodes, but so narrow as to leave most of the scape exposed; inflorescence ample, lax, at least tripinnate (only the apical part known), glabrous (at least in age); primary bracts broadly triangular, several times shorter than the naked flattened sterile bases of the branches, entire; branches spreading with the ultimate divisions pendent; racemes to 20 cm. long including the short naked sterile base, densely many-flowered, the rachis strongly angled; floral bracts broadly ovate, acuminate, 7 mm. long, entire, subcoriaceous; flowers obscurely pedicellate, reflexed; sepals free, heteromorphic, unequal, elliptic, the anterior one shorter than the others, ecarinate, the posterior ones 6 mm. long, alate-carinate; ovary $\frac{1}{3}$ inferior; seeds wingless.

Colombia: Comisaría del Vaupés, Río Negro below its confluence with Río Casiquiare, San Felipe (El Castillo). December 12, 1947, *Richard Evans Schultes & Francisco López 9321* (Type in U.S. Nat. Herb. Nos. 1989460, 1989461).

**Vriesia Schultesiana** *L. B. Smith sp. nov.*

Acaulis; foliis haud bulbose rosulatis, vaginis distinctis, dense ferrugineo-lepidotis, laminis linearibus, planis; scapi vaginis haud vel vix imbricatis; inflorescentia simplicissima; rhachi subtereti; bracteis florigeris laxe imbricatis, late ellipticis, sepala multo superantibus, ecarinatis, nervatis; floribus distichis; sepalis liberis, oblongis,




a, habit, one third natural size. b, inflorescence, about natural size. c, sepal, natural size. d, petal and stamens, natural size.

subtruncatis, parvis, sparse lepidotis; petalis basi ligulis binis obtusis auctis; staminibus inclusis.

Stemless, 12–23 cm. high; leaves 8–15 in a fasciculate rosette, 22 cm. long, sometimes exceeding the inflorescence, green, concolorous, the sheaths broadly ovate, covered with coarse subappressed ferruginous scales, the blades linear, acuminate, 3.5 mm. wide, ferruginous-lepidote, soon becoming glabrous; scape erect or ascend-

ing, very slender, glabrous; scape-bracts erect and enfolding the scape, barely or not imbricate and exposing sections of the scape but their caudate apices always exceeding the internodes, very obscurely lepidote; inflorescence simple, linear, complanate, 4–6 cm. long, 1–1.5 cm. wide; rhachis slender, subterete; floral bracts laxly imbricate and exposing parts of the rhachis, broadly elliptic, subacute, 15–18 mm. long, much exceeding the sepals, ecarinate, subcoriaceous, nerved when dry, glabrous outside or sparsely lepidote near the apex, pale yellow (! Schultes); pedicels very short, broadly obconic; sepals free, oblong, obliquely subtruncate, 8.5 mm. long, ecarinate, thin, nerved, sparsely lepidote; petals oblong, obtuse, 13 mm. long, bearing 2 large, obtuse, entire scales at base; stamens included; capsules shorter than the floral bracts.

In my key to the Tillandsiae (in Contributions from the U.S. National Herbarium 29 (1951) 448–455) this species would fall next to *Tillandsia incurva* Griseb. and *T. patula* Mez, since the arrangement is frankly artificial. Its pale leaf-sheaths and small dimensions throughout easily distinguish it from both without reference to its appendaged petals. The nearest species of *Vriesia* is *V. Barclayana* (Baker) L. B. Smith, but this last differs basically in its alate rhachis, while also being immediately distinguishable by size and brown leaf-sheaths.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Raudal de Jirijirimo. "On ledge of conglomerate quartzite. Savannah (caatinga)." March 1951, *Richard Evans Schultes 12088* (TYPE in U.S. Nat. Herb. No. 2048059).—Same locality. November 25–26, 1951, *H. García-Barriga 13710*.

## VELLOZIACEAE

**Vellozia Maudeana** *R. E. Schultes sp. nov.*

Frutex usque ad duos pedes altus. Caudex subligno-sus, erectus vel saepe procumbens, basi ad 6–8 cm. in

diametro, quinque- vel sex-furcatus, apparenter fibrosus cum radicibus internis foliorum vaginis circumdatis, vaginis comparate parvis, griseo-stramineis, persistentibus, arcte adpressis, subspiraliter imbricatim dispositis, vestigiorum apicibus laciniatis et valde revolutis obtectus, in parte superiore distincte lineatis. Folia in apice ramorum subrosulata conferta, non numerosa (plusminusve decem ad quattuordecim), rigide erecta, sicca, firme coriacea, utrinque glabra, margine infra medium et in foliis juvenilibus omnino pilis conspicuis albis, simplicibus vel irregulariter plurichotome ramosis, usque ad 2 mm. longis armata, utrinque sed subtus spiraliter sulcata cum vena centrali atque venis minoribus viginti octo valde elevatis, pallide viridia sed basim versus paullo rubentia, linearia, margine integra, valde stramineo-revoluta, apice longissime et sensim attenuata, basi non dilatata, plerumque 27–34 cm. longa (sed vulgo breviora), 6–8 mm. lata. Flores fragrantes, solitarii, pseudoterminales, magni speciosissimique, albi sed basim versus pallide rosei vel pallide rubri, foliis paullo breviores, longe pedunculati; pedunculo filiformi, triquetro, inferne glabro sed superne viscoso-glanduloso, minute squamoso-echinato, rubro-purpureo, usque ad 14 cm. longo sed saepe breviore. Perigonii tubus tenuis gracilisque, cylindricus, 75 mm. longus et 4 mm. in diametro, extus densissime purpureo-viscoso-glandulosus, ovarii regione valde inflatus; limbus infundibuliformis, vivo 6.5–7 cm. in diametro, segmentis membranaceis, imbricatis, subspathulato-ellipticis, apice irregulariter rotundatis, vivo 45 mm. longis, basi 3–4 mm. (sed in parte latiore usque ad 12–15 mm.) latis, glabris sed extus in parte inferiore glandulosis. Stamina duodecim, tepalis multo breviora; antherae subaequales, elongissime cylindricae, 9 mm. longae (8–10 mm.), glabrae, flavae, filamentis 1 mm. longis. Ovarium oblongo-clavatum, apice truncatum, paleis illis pedunculi similibus sed multo

robustioribus, viscoso-glandulosis, luteis, dense ornatum. Stylus flavus, robustius filiformis, 8.5 cm. longus, 1–1.3 mm. in diametro, trigonus, inclusus, stamina multo superans. Stigma flavum, trilobatum, crassissimum, 4–4.5 mm. in diametro. Capsula elongato-ovata, 10 mm. × 6 mm., dense et grossiuscule glanduloso-echinulata, conspicue trivalvata, protractione usque ad 6 cm. longa, basi 4–5 mm. in diametro sed apice filiformi, dense echinulata, nunc aliquantulum arcuata, nunc stricta coronata.

*Vellozia Maudeana*, one of the most beautiful species of the genus, can easily be distinguished from other Colombian species by the unusual coloration of its flowers. In all other known species of northern South America, the flowers are entirely white, but those of *Vellozia Maudeana* are a deep pink or red towards the base, with a red-purple peduncle. Some of the flowers are a pale pink for fully half their length. This tendeney towards a pink or red coloration can be seen even in the vegetative parts of the plant, for the basal portions of the leaves are likewise of a slightly reddish hue. I have studied a number of individuals at the type locality and find that this is a constant character.

There are, nevertheless, other important characters which serve to set *Vellozia Maudeana* apart. The number of the stamens is twelve, whereas all other species from Colombia have either fifteen or eighteen. The subspatulate-elliptic shape of the segments of the tube is also apparently peculiar to this species. The flowers of *Vellozia Maudeana* have a strawberry-like fragrance which I have never before noted in the genus. The flowers of other Colombian species seem to lack any odor.

In habit, *Vellozia Maudeana* approaches perhaps most closely to *V. macarenensis* Philipson, for it is small and does not branch so profusely as do most of the other species. There are, however, no indications that these two

concepts are morphologically closely allied. In some respects, *Vellozia Maudeana* resembles *V. Dumitiana* R.E. Schultes, especially in having a small number of leaves at the apex of each stem; but the latter is, in general, a much more robust plant than the former, and there are significant differences in floral structure.

*Vellozia Maudeana* grows on the grotesquely eroded quartzitic mounds of the extensive savannahs of the Río Karurú which are known by the Kubeo Indian name of *Goo-rán-hoo-da*, meaning "savannah of the deer." These savannahs are ecologically the same and, as I have ascertained from reconnaissance flights, are continuous with the savannahs of the Ríos Kubiyú and Kuduyarí-Kañendá and Yapobodá respectively. *Vellozia Maudeana* has not been found at Kañendá nor at Yapobodá, where *V. lithophila* R. E. Schultes, the only representative of the genus at these localities, is one of the dominant shrubs. These two species, notwithstanding their geographical proximity, are not closely related.

*Vellozia* usually prefers rocky habitats where conditions of chersophytic or psammophytic drought prevail, but the xerophytism which *Vellozia Maudeana* withstands at Goo-rán-hoo-da is extreme even for this genus. The plant seems to prefer craggy exposures or knobs of bare quartzite which erosion has left standing here and there on the flat sandy stretches in the extensive savannah. Most closely associated with *Vellozia Maudeana*, a shrub which usually stands quite alone amidst a harsh or gorsey growth of grasses, sedges and prostrate creepers, are *Navia caulescens* var. *minor* (filling in cracks and crevices in the rocks) and *Leitgebia colombiana*, *Bombax coriaceum* and a red-flowered *Calliandra* (on the flat expanses). All of these plants are, like *Vellozia Maudeana*, adapted to withstand extreme radiation and heat in an area where no shade whatsoever lessens the strength of the tropical sun.

I have named this beautiful novelty in honor of my mother, Maude Bagley Schultes.

COLOMBIA: Comisaría del Vaupés, Río Karurú (tributary of Río Vaupés), Mesa de Yambí, quartzite savannah Goo-rán-hoo-da. Alt. about 950 feet. General location: Lat. 1°20′ N, Long. 71°20′ W. "Flowers fragrant, with scent of strawberries, white, base of tube red outside, becoming dark purple at very base, often very pale pink even half way up tube. Stigmas bright yellow. Plants in clusters, much-branched, leaves all short, marginal hairs very prominent. Plants many-flowered. Basal diameter at ground up to 3½–4 inches. Kubeo name = *dá-ko-ree.*" April 15–16, 1953. *Richard Evans Schultes & Isidoro Cabrera 19120* (TYPE in Herb. Gray).

## LORANTHACEAE

**Psittacanthus peronopetalus** *Eichler* in Martius Fl. Bras. 5, pt. 2 (1868) 31, t. 9, fig. 4.

This species has not hitherto been collected from Colombia. The material cited in the original description came from Manáos and Teffé (Ega) in Amazonian Brazil.

COLOMBIA: Comisaría del Vaupés, Río Naquieni, Cerro Monachí. June 1948, *Richard Evans Schultes & Francisco López 10086.*

## MALPIGHIACEAE

**Tetrapteris methystica** *R. E. Schultes sp. nov.*

Frutex scandens robustior, trunco nigro cum cortice. Rami cinereo-fulvi, internodiis 4–10 cm. longis. Ramuli teretes, obscurissime canaliculati, novellissimi minute incano-sericei vel leviter schistacei, 0.8–3.3 mm. in diametro. Folia firme papyracea vel chartacea, ovata, apice longiuscule acuminata, basi plerumque bene rotundata, margine integra sed saepe leviter revoluta, 6–8.5 cm. longa, 2.5–5 cm. lata, valde discoloria, supra vivo viridia clara (sed siccitate glaucino-straminea), minute et remote sericea, subtus vivo cinereo-viridia, densius sericea et cerae lamina obtecta; nervis secundariis arcuatis, utrinque sex ad octo, supra prominulis, subtus prominentibus sed non conspicue elevatis, nervis tertiis inconspicuis, densis-

sime reticulatis, petiolo usque ad 5 mm. longo, canaliculato, aliquid incrassato, dense cinereo-sericeo. Stipulae mox caducae, parvae. Inflorescentiae pseudocorymbosae, pauciflorae (ut videtur usque ad quattuor- vel quinqueflorae), in paniculis axillaribus, foliis multo brevioribus, usque ad 2.5 vel 3 cm. longis, vivo probabiliter plusminusve 15 mm. in diametro, apparenter sine foliolis (?); pedunculi internodio inferiore 10 mm., pedicellis plusminusve 5 mm. longis, pedunculis pedicellisque densius sericeis. Bracteae subulatae, plerumque 1.5 mm. longae. Bracteolae breviter ovato-triangulares vel saepe suborbiculares, plusminusve 1.5 mm. longae. Sepala crassa, extus pilosa, ovato-lanceolata, apice subacuta, usque ad circiter 3 mm. longa, nigris cum glandulis octo, ovalibus, plerumque 2.5 cm. longis, basi extus pilosis, plusminusve 0.5 mm. superantibus. Petala patentia, membranacea, maxima pro parte lutea sed parte centrali fulva vel rubra, limbo elongato-orbiculari vel ovali, apice rotundato, basi obtuso vel rotundato, margine suberenulato (rarenter subintegro), parte centrali dorsali aliquid carinato-incrassato, 4 mm. longo, plerumque 2.5 mm. lato, ungui crasso, 0.5 mm. longo, aliquid reclinato. Stamina non inclusa, aequalia; antherae allantoidae, 1.3 mm. longae, 0.4 mm. in diametro, valde arcuatae, filamentis bene complanatis, 1.3 mm. longis, basi usque ad 0.4 mm. latis. Styli aequilongi, apice leviter recurvi. Ovarium densissime albopilosum. Samarae ad nucem sericeae, demum glabrae; nux fere complanato-ovoidea, 5 mm. $\times$6 mm. $\times$2 mm.; areola ventralis ovata, circiter 3 mm. alta; alae chartaceae, fulvae, laterales inferiores obcuneiformes, apice truncato-rotundatae, 12 mm. longae, apicem versus 2.5 mm. latae, superiores similes sed saepe subovoideae et paulo majores; alula dorsalis subsemiorbicularis, 3.5–4 mm. longa, illae intermediae ovatae, 7–8 mm. longae.

*Tetrapteris methystica* is sharply set apart from almost

all other South American species of the genus by its strongly discolorous leaves. In many respects, it seems to approach most closely to *Tetrapteris discolor* (G. F. W. Meyer) DC., a rather polymorphic species which, with its several varieties, occurs from Guatemala and the West Indies south to Bolivia. *Tetrapteris methystica* may be distinguished from *T. discolor* by its smaller and more long-acuminate leaves which are, even in the adult stage, sericeous on both surfaces and which are covered beneath with a thick layer of wax; by its apparent lack of foliolaceous stipules (which, if they do occur, are extremely caducous); by having a more corymbiform inflorescence; by its long allantoid (instead of obovoid) and recurved or arcuate anthers; by its rather acute and loosely sericeous (instead of rounded and glabrous) sepals with smaller glands; by its basally rounded (instead of strongly sagittate) petal-blades; and by the shape of the upper lateral wings of the samara, which are obcuneiform in outline.

*Tetrapteris methystica* has been so named because it is employed by the Makú Indians of the Ira-Igarapé (and possibly by other tribes of the upper Río Negro-Vaupés area) as the source of a strong narcotic drink. It is known as *caapi*, the same name which is applied to the related *Banisteriopsis Caapi* (Spruce ex Griseb.) Morton, the source of the well known narcotic discovered by Spruce a century ago in the same region (cf. Spruce, R. [ed. A. R. Wallace] "Notes of a botanist on the Amazon and Andes" 2 (1908) 414 ff.).

Inasmuch as I am preparing a comprehensive article on the malpighiaceous narcotics of South America, a discussion of the use of *Tetrapteris methystica* will be deferred for that general paper. The use of a member of the genus *Tetrapteris* as a narcotic was first reported in the literature in 1952 (Hill, A. F. "Economic Botany"

ed. 2 (1952) 283, t. 143), on the basis of the collection described above.

Brazil: Estado do Amazonas, Upper Rio Negro Basin, Ira-Igarapé, affluent of Rio Tikié, Porto Makús, June 25, 1948, *Richard Evans Schultes & Francisco López 10184* (Type in Herb. Gray).

## Euphorbiaceae

**Senefelderopsis** *Steyermark ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 15 (1951) 45.

**Senefelderopsis chiribiquetensis** (*Schultes & Croizat*) *Steyermark ex Schultes* ibid. 47.

**Senefelderopsis Croizatii** *Steyermark ex Schultes* ibid. 46, t. 16.

Through an editorial error, the generic and specific descriptions cited above were published under the family heading *Anacardiaceae*. The genus is a member of the *Euphorbiaceae*.

## Sterculiaceae

Recent investigations of *Herrania* in the field and herbarium have led to several additions to our knowledge of this interesting sterculiaceous genus.

To the best of my knowledge, the first analysis of the pollen-grains of *Herrania* is that effected by Dr. Thomas van der Hammen of the Servicio Geológico Nacional de Colombia and published herewith. The species studied was *Herrania tomentella* which is described in this paper.

*Herrania tomentella* R. E. Schultes.

Pollen collection Serv. Geol. Nac. IV 86. Collection Col. 34377.

Pollen grains: tricolporate, reticulate, subsphaeroidal; granulae of the muri visible but not separated. Lumina of reticulum ± irregular of size, rather large, polygonal, smaller near the colpae. In the lumina, rather faint granulae are visible.

Colpae clear, edges separated; pores clear, without ectexine ele-

ments; sometimes indications of small transversal furrows.
Magnitudo pollinis: media (28–33 $\mu$).
Magnitudo luminum: meso-macra (2–4.7 $\mu$) and smaller.
Index pollinis: subsphaeroidea (1–1.12); ('prolate sphaeroidal' of Erdtman).
Index areae poli: middle (0.30–0.35).
Index exinae: middle (0.05–0.08).

Van der Hammen further reports that *Theobroma*, *Guazuma*, *Sterculia* and *Herrania* have tricolporate and reticulate pollen-grains, but that the grains of *Waltheria* and *Helicteres* are of different types. A comparison of the four genera which have tricolporate and reticulate grains leads to the really unexpected conclusion that, insofar as pollen morphology is concerned, there is no evidence that *Herrania* and *Theobroma* are very close allies. On the contrary, the pollen-grains of *Theobroma* resemble those of *Guazuma* rather than those of *Herrania*. He compares the grains of *Theobroma Cacao* L. and of *Herrania tomentella* as follows: "The grains of *Theobroma Cacao* are subsphaeroidal ('oblate sphaeroidal' of Erdtman); index pollinis 0.8 0.9; magnitudo pollinis ± 22 $\mu$. The polar area is relatively much larger than in those of *Herrania*, the colpae are very narrow, unclear and short. Pores are small and not very clear; lumina of ret much smaller than in those of *Herrania* (greatest size measured 1 -1.75 $\mu$), and more regular. Exine (including sculpture) relatively thicker than in those of *Herrania*."

This evidence of relationship drawn from a study of pollen-grains should be of interest, inasmuch as there has been a strong tendency in the past to treat the species of *Herrania* as constituting a section of *Theobroma*.

The following notes comprise the description of an hitherto unknown species, reports of new range extensions for several species and miscellaneous information resulting from the collection of more complete material of several concepts.

Some of the observations have arisen from my own studies in the Amazonian areas of Colombia. Others represent the work of the Anglo-Colombian Cacao Collecting Expedition which has been exploring the forests of Colombia for material of *Theobroma* and *Herrania* since July 1952, and which it has been my good fortune to accompany on several trips into the Comisarías del Amazonas, Putumayo and Vaupés.

**Herrania albiflora** *Goudot* in Ann. Sci. Nat. Paris, sér. 3, 2 (1844) 230, t. 5, figs. 1–10.

In spite of the reddish hue reported for the flowers by the collector (I suspect that this refers to the outside of the calyx-lobes), *Aristeguieta 1598* is referable to *Herrania albiflora*. It represents the second Venezuelan collection of this species, the first being *Tejera 268* from near Perijá in the Estado de Zulia. At the present time only two species of *Herrania* are known from Venezuela: *H. albiflora* and *H. lemniscata* (Schomb.) R. E. Schult. *H. kanukuensis* R. E. Schult. and *H. Camargoana* R. E. Schult., from boundary regions of adjacent countries, are also to be expected in the Venezuelan flora.

Venezuela: Estado de Barinas, Fundo Paiva, Santa Bárbara de Barinas. "Arbusto de más o menos 2 m. de alto. Fls. caulinares, rojizas. Frutos de más o menos 10 cm. de largo, amarillentos, encierran una pulpa agri-dulce, comestible. Abunda en el estrato arbustiforme de la selva. N.v.: *cacaíto*." February 1952, *L. Aristeguieta 1598*.

**Herrania breviligulata** *R. E. Schultes* in Caldasia no. 4 (1942) 20. t.p. 21, 24; Bot. Mus. Leafl. Harvard Univ. 16 (1953) 78, t. 12.

On a recent trip to the Comisaría del Putumayo additional material of *Herrania breviligulata* was found at Mocoa, the type locality of this species. Hitherto, this strikingly distinct concept has been known through but two collections: the type, *Schultes & Smith 2050*, a flow-

ering collection; and *Mexia 7328*, from Ecuador, which is sterile. The fruit has not been known, but several of the collections made in March 1953 and cited below, are in fruit. We are, therefore, able to offer the following description of the capsule:

Capsula (unica visa non matura) oblongo-ovoidea, 10 cm. longa, 5 cm. in diametro, apice abruptissime acuminata, basi haud indentata, petiolo robusto usque ad 2 cm. longo, quinque cum costis primariis regularibus, grossiuscule hebetato-rotundatis, usque ad 7 mm. altis et basim versus usque ad 8–10 mm. latis, et cum quinque costis secundariis similibus sed paulo minoribus, costis omnibus proximis sine costis fibrosis horizontalibus, pericarpio duro, omnino densissime atque molliter stellato-velutino.

COLOMBIA: Comisaría del Putumayo, Mocoa. "Suckers, 3 m. tall, from an old tree. One immature fruit, no flowers. In second growth." March 17, 1953, *F. W. Cope & P. Holliday* (*Anglo.-Col. Cacao Coll. Exped.*) *78*.—Comisaría del Putumayo, Río Caquetá, Puerto Limón. "Fruit 10 cm. long×5 cm. in diameter." March 17, 1953, *Richard Evans Schultes & Isidoro Cabrera 18720*.

**Herrania Camargoana** *R. E. Schultes* in Bot. Mus. Leafl. Harv. Univ. 14 (1950) 120, t. 29, 32.

*Herrania Camargoana*, hitherto known only from the Brazilian basin of the upper Rio Negro, has recently been collected in Colombia along the lower course of the Río Vaupés, on the Río Papurí and on the Río Negro, just below the confluence of the Río Guainía and the Casiquiare.

This species, in Brazil, was always found in association with granitic mountains, occurring most frequently near or at the summits. The Anglo-Colombian Cacao Collecting Expedition found the tree growing in sandy situations along the river banks of the Vaupés and Papurí, and the material from the Río Negro was collected along

the main river and in abandoned house sites on an affluent creek.

All of the fruits of the many Brazilian collections were a brilliant blood-red, a character which was especially emphasized in the original description, for the reason that only one other species—*Herrania laciniifolia* Goudot ex Triana & Planch. of the Colombian Andes—is known to have capsules of this color. It is important now to note that all of the fruiting Colombian collections cited below have capsules which give definite evidence of ripening yellow. It is obvious, then, that two colors are assumed by the fruit of *Herrania Camargoana*. Whether the red color is due to some mineral deficiency (inasmuch as the plants with fruits of this unusual color grow on very sterile granite rock-soil) or not we are, as yet, unable to say.

Colombia: Comisaría del Vaupés, Río Negro, Caño Maiyabo, near San Felipe. "Tree 16 ft., first collection of this species in Colombia. Leaves and one ripe fruit (sent to Trinidad); native, in forest. Flowers pale yellow." October 27, 1952, *R. E. D. Baker* (*Anglo.-Col. Cacao Coll. Exped.*) *38*.—Same locality and date. *Richard Evans Schultes & Isidoro Cabrera 18050*.—Comisaría del Vaupés, Río Negro, San Felipe. "Tree 15 feet, in full flower, no fruit. On old house site; seed said to have been brought from the locality of No. 35." November 5, 1952, *R. E. D. Baker* (*Anglo-Col. Cacao Coll. Exped.*) *39*.—Comisaría del Vaupés, caño opposite Inambú. November 18, 1952, *B. G. Bartley & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *45*.

Brazil: Estado do Amazonas, creek near north end of Inambú, Río Uaupés. "Tree 4 m. Fls. Cal. purple-crimson; pet. deep crimson on dull yellow; ligules whitish and purple-crimson at extremities, 9–12 cm. long. Fruit 8–8.7×6 cm." November 17, 1952, *B. G. Bartley & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *56*.

**Herrania nycterodendron** *R. E. Schultes* in Caldasia no. 6 (1943) 21, t. p. 22, 26; Bot. Mus. Leafl. Harvard Univ. 14 (1950) t. 35.

Known hitherto only from the Putumayo River, the boundary between Perú and Colombia, *Herrania nycterodendron* has recently been collected on the Caquetá

at La Pedrera and on the Río Caguán, an affluent of the upper Caquetá. It is relatively frequent in these localities. At La Pedrera, it occurs with *Herrania nitida* (Poepp.) R. E. Schult. on flood-banks and islands.

From the collection *Schultes & Cabrera 17778*, we now know that the capsule of *Herrania nyeterodendron* ripens yellow, as in most other species of the genus. The buds of *Schultes & Cabrera 17773* had been attacked by insects and were hollow and devoid of most floral parts. We can say, however, that the buds are conic, almost pointed, not globose as in most species.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, La Pedrera. "Tree 6–7 m., 10 cm. diam. at base. Flowers not seen." September 25, 1952, *R. E. D. Baker & F. W. Cope* (*Anglo-Col. Cacao Coll. Exped.*) *14*.—Same locality. "A young plant without flowers or fruit." September 27, 1952, *R. E. D. Baker & F. W. Cope* (*Anglo-Col. Cacao Coll. Exped.*) *20*.—Comisaría del Caquetá, Río Caucaya, Laguna Primavera. "Tree 6–8 m., unbranched. In forest. Ripe fruit 13.5×4.5 cm." April 3, 1953, *F. W. Cope & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *93*.—Comisaría del Caquetá, Río Caguán, Cartagena. "Tree 4–5 m., unbranched. In forest. Ligules of dead flowers 12 cm." April 20, 1953, *F. W. Cope & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *108*.—Comisaría del Caquetá, Río Caguán (camp 2). "Tree 6–8 m., unbranched. In forest. Flowers and fl. buds, but no fruits. Cushions whole length of trunk, infl. with about 45 fls. Fls. deep dull purplish crimson and cream. Ligules 7 cm." April 22, 1953, *F. W. Cope & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *109*.—Comisaría del Caquetá, Río Caguán (camp 2). April 22, 1953, *F. W. Cope & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *110*.—Comisaría del Caquetá, Río Caquetá (camp 6). May 9, 1953, *F. W. Cope & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *128*.—Comisaría del Caquetá, Río Caquetá, Piedra Blanca. May 11, 1953, *F. W. Cope & P. Holliday* (*Anglo-Col. Cacao Coll. Exped.*) *131*.—Comisaría del Amazonas, Río Caquetá, La Pedrera. "On low flood-bank. Hairs soft, golden brown." October 6, 1952, *Richard Evans Schultes & Isidoro Cabrera 17771*.—Same locality. "Treelet 18 ft. tall. Basal diameter 6 inches. Hairs golden brown. Buds purplish maroon, conic, almost pointed." October 7, 1952, *Richard Evans Schultes & Isidoro Cabrera 17773*.—Same locality. "Treelet 18 ft. tall." October 7, 1952, *Richard Evans Schultes & Isidoro Cabrera 17776*.—Same locality. "Fruit yellow. Tree 20 feet tall. Diameter 6 inches." October 7, 1952, *Richard Evans Schultes & Isidoro Cabrera 17778*.

**Herrania pulcherrima** *Goudot* in Ann. Sci. Nat. Paris, sèr. 3, 2 (1844) 232, t. 5, figs. 11–12.

*Theobroma pulcherrimum* (Goudot) de Wildeman Pl. Trop. Grande Cult. (1902) 89.

It is often overlooked that de Wildeman made the combination *Theobroma pulcherrimum* half a century ago. This combination is usually attributed to Pittier (Man. Pl. Usuales Venez. (1926) 147).

The type specimen of *Herrania pulcherrima* has always been thought to be in Paris, but, as in the case of *H. albiflora* (cf. Schultes in Bot. Mus. Leafl. Harvard Univ. 16 (1953) 75), there is material in Geneva which may well be the true type from which Goudot's description and illustrations (at least of the flowers) were made. Goudot (*loc. cit.* 232) spoke of the type as inhabiting the great forests situated between the Ríos Ariari and Guayabero, affluents of the upper Orinoco system in the Colombian Llanos.

The Geneva material consists of two sheets. It is labelled in Goudot's hand: "*Herrania pulcherrima* mihi. An. Sci. Nat. 1844. Llanos del Orinoco, pueblo d'Iraca, San Juan. Flos. Dec." One sheet consists of a length of golden-tomentose stalk about one foot long, a very young leaf and young capsules. One of the envelopes on the sheet has the Koregwahe Indian name (reported by Goudot in the original description): "*cacao cahouai*—Llanos." Another envelope, on the outside of which Goudot has written "CN. 2 theobroma affinis *Herrania pulcherrima*," has a completely and beautifully dissected flower, the separate parts glued to the inside of the envelope. There can be no doubt but that Goudot made his drawing of the flower of *Herrania pulcherrima* (*loc. cit.* t. 5, figs. 11–12) from this same dissection.

The leaf which is preserved at Geneva could hardly have served as a basis for Goudot's excellent description,

but a study of the material and the description would seem to indicate that the Paris material represents the type of the leaf.

It may be of value to publish a few notes on Goudot's dissection of the flower. The three sepals are laid flat, the very slightly puberulent inner surface exposed. Two are rather broadly ovate, about 15 mm. long and 5 mm. wide (all measurements taken on dried material), apically rounded; the third, somewhat elliptic, 18 mm. long and 4 mm. wide, apically blunt-pointed. The five petals are all about equal, strongly cucullate, very densely muricate-papillose or granulose externally, papillose internally in six longitudinal lines, the ligules up to 90 mm. long, 2.5 mm. wide immediately above the constriction at the junction with the petal. The staminodes are lanceolate-elliptic, 15 mm. long, 4–4.5 mm. wide, muricate-granulose and apically so strongly trifid that the tip appears to be mucronate. This was noted by Goudot, when he described the staminodes as apically "mucronés et échancrés"; but, in this drawing, he indicated the tip as extremely acute. The ovary is very densely yellowish tomentose.

It is unusual to find a species of *Herrania* which occurs both east and west of the Andes, as well as in the valley between the several Andean chains in Colombia. Yet that is apparently the distribution of *Herrania pulcherrima*. Goudot said that he had found it in the deep valleys of the eastern Andean chain, near Savana Grande and Payme where, however, it seemed to be rare and isolated. I have seen no Goudot specimen from this locality; but it is very significant, I think, to note that all earlier and a number of later collections were made, not in the eastern Llanos, but within the Andean cordillera itself.

Vegetatively, *Herrania pulcherrima* can easily be con-

fused (and has been) with *H. tomentella*, a species growing on the eastern Llanos at the foothills of the Andes where the type of *H. pulcherrima* was collected. The differences between these two species are discussed below under *Herrania tomentella*.

The earliest reference to *Herrania pulcherrima* is Eloy Valenzuela's minute description of the plant written in Mariquita in the Departamento del Tolima, Colombia, in 1784, while he was engaged in the work of the Mutis Botanical Expedition in New Granada.

The specific name *pulcherrima*, meaning "very beautiful," could not be more appropriate. It recalls Valenzuela's picturesque remark that the flower of *Herrania pulcherrima* or *cacao esquinado* "could be considered as the greatest marvel of the plant kingdom and one can hardly believe that nature, as frugal and simple as she is, would have used so many ribbons and so much ornamentation to adorn herself almost as ostentatiously as in the fashions."

COLOMBIA: Intendencia del Meta, Iraca, San Juan [de Arama], Llanos Orientales. December 1844. *J. Goudot s.n.*—Departamento de Boyacá, region of Mount Chapon, extreme western part of the department, northwest of Bogotá. Heavy forest. El Umbo region. Alt. 3000 feet. "Tree 10 feet high. Flowers blood red." September 13, 1932, *A. E. Lawrance 437*.—Departamento de Cundinamarca, Municipio de El Peñon, Hacienda "Curiche." Alt. 1000 meters. "Varas altas y delgadas, de 4 metros." September 2, 1942, *R. Jaramillo-Mejía 202*.

### Herrania tomentella *R. E. Schultes sp. nov.*

*Herrania nitida* (Poeppig) R. E. Schultes var. *aspera* (Karsten & Triana) R. E. Schultes in Bot. Mus. Leafl. Harvard Univ. 14 (1950) 130, *pro parte*.

DISTRIBUTION: Eastern foothills of the Andes, in the Orinoco drainage area of Colombia.

COMMON NAMES: *cacao de monte; cacaoito.*

Arbuscula parva, tenuis, venusta, vulgo plusminusve octo ad duodecim pedes alta; erecto cum trunco tereti, circiter tria pollices in diametro, cortice nigro obtecto; prope trunci apicem parce ramosa vel eramosa; ramis tomentosis. Ramuli dense villosi, ferrugineo-aureis cum pilis persistentibus. Folia amplissima, digitata, septemfoliolata, longissime petiolata. Petioli teretes, basi aliquid constricti, densissime et molliter aureo-ferrugineo-tomentelli, usque ad 60 cm. longi, 9–10 mm. in diametro. Stipulae persistentes, lineares, dense aspero-tomentellae, usque ad 3 cm. longae, 2 mm. latae. Foliola sessilia, oblanceolata vel late lanceolato-ovata, erecta, valde inaequalia, membranaceo-papyracea, apice acuminata, basi attenuata, margine dimidio superiore regulariter et leviter (praesertim apicem versus) sinuato-dentata et omnino pilis vel pseudociliis stellatis armata, 30–50 cm. longa, 13–20 cm. lata, supra aspera, sparse cum pilis fuscis solitariis, subtus submolliter et dense tomentella cum pilis longis stellatis ferrugineo-aureis. Inflorescentiae fasciculatae, comparate pauciflorae, e trunci partibus inferioribus prorumpentes. Pedicelli articulati, 7 mm. longi, 1.5 mm. in diametro, stellato-pilosi. Alabaster floris globosus, 15 mm. in diametro, dense stellato-pilosus. Calyx trifidus, fere usque ad basim divisus, subcymbiformis. Sepala vulgo inaequalia, suberassa, atropurpurea, in alabastro valde valvata, extus grossiuscule stellato-pilosa, intus minutissime granuloso-pulverulenta, duo interiora rotundato-ovata, margine integra, apice perfecte rotundata, plusminusve 14 mm. longa, 10 mm. lata; sepalum exterius vulgo triangulari-ellipticum, margine integrum, apice subacutum, 13–14 mm. longum, basi 6–7 mm. latum. Petala quinque, basi sessilia, obovata vel ovata, apice valdissime concavo-cucullata, circiter 8 mm. longa, 7 mm. (saepe usque ad 8 mm.) lata, atrosanguinea cum nervis purpureis, extus minute muricato-verrucosa, su-

perne in ligulam extensa. Ligulae lineares, plusminusve 70 mm. longae, basi 3 mm. latae, apicem versus filiformes, atrosanguineae sed apicem versus roseae. Tubus stamineus quinque-divisus cum staminibus invicem uno- et duoantheriferis et cum filamentis brevibus liberisque. Staminodia petaloidea, atrosanguinea, membranacea, elliptica, margine integra, apice acuta, 14–15 mm. longa, 6–7 mm. lata, utrinque aliquid subverrucosa. Fructus non numerosi, ellipsoidei, usque ad 9 cm. longi, 4 cm. in diametro, apice longe attenuati sed prope apicem aliquid constricti, apice ipso obtuso et saepe contorto, basi non indentati, pedunculati, cum sepalorum vestigiis persistentibus, pedunculo articulato, 3 cm. longo, 4 mm. in diametro, omnino dense et minutissime velutino-pilosiusculi, tactu molles et sine pilis urticantibus, profundissime decemcostati, quinque cum costis primariis crassis et hebetatorotundatis, 8 mm. altis, atque quinque cum costis secundariis similibus sed minoribus, 4–5 mm. altis, transverse leviter fibroso-rugosi, pericarpio crassiusculo, sublignoso, maturitate flavi dicitur. Semina plusminusve sexaginta, in pulpa alba inclusa.

A small tree, slender and graceful, commonly about eight to twelve feet in height. Trunk erect, about three inches in diameter, covered with blackish bark, sparsely branched near the top or unbranched. Branches tomentose. Branchlets densely villose, with golden-rust-colored and persistent hairs. Leaves very large, digitate, sevenfoliate, very long-petiolate. Petioles round, somewhat constricted at the base, very densely and softly golden or ferrugineous, tomentellous, up to 60 cm. long, 9–10 mm. in diameter. Stipules persistent, linear, densely rough-tomentellous, up to 3 cm. long, 2 mm. wide. Leaflets sessile, oblanceolate or broadly lanceolate-ovate, erect, strongly unequal, membranaceous to papyraceous, apically acuminate, basally attenuate, the margin both

regularly and lightly sinuate-dentate in the upper half, but especially towards the apex, and everywhere armed with cilia-like stellate hairs, 30–50 cm. long, 13–20 cm. wide, above rough to the touch with sparse single brown hairs, beneath rather softly and densely tomentellous with long golden-rust-colored stellate hairs. Inflorescence fasciculate, relatively few-flowered, growing from the lower portion of the trunk. Pedicels articulate, 7 mm. long, 1.5 mm. in diameter, stellate-pilose. Buds globose, 15 mm. in diameter, densely stellate-pilose. Calyx three-parted, divided almost to the base, subcymbiform. Sepals commonly unequal, rather carnose in life, dark purplish, strongly valvate in bud, externally rather coarsely stellate-pilose, internally very minutely granulose-pulverulent; the two interior sepals round-ovate, the margins entire, apically perfectly rounded, about 14 mm. long, 10 mm. wide; the exterior sepal usually triangular-elliptic, the margin entire, apically subacute, 13–14 mm. long, basally 6–7 mm. wide. Petals five, basally sessile, obovate or ovate, apically very strongly concave-cucullate, about 8 mm. long, 7 mm. (often up to 8 mm.) wide, dark blood-red with purple nerves, externally minutely muricate-verrucose, ligulate. Ligules linear, about 70 mm. long, basally 3 mm. wide, filiform near the apex, dark blood-red, but pinkish near the tip. Staminal tube five-parted with stamens bearing one and two anthers alternately and with short, free filaments. Staminodes petaloid, dark blood-red, membranaceous, elliptic, marginally entire, apically acute, 14–15 mm. long, 6–7 mm. wide, somewhat verrucose on both surfaces. Fruits not numerous, ellipsoid, up to 9 cm. long, 4 cm. in diameter, apically long-attenuate, but near the tip slightly constricted, the tip itself obtuse and frequently twisted, basally not indented, pedunculate, with remnants of the persistent sepals (peduncle articulate,

3 cm. long, 4 mm. in diameter), everywhere densely and very minutely velvety-pilose, soft to the touch and without stinging hairs, very deeply ten-costate, the five primary ribs thick and bluntly rounded, 8 mm. high, the five secondary ribs similar but smaller, 4–5 mm. high, transversely lightly fibrous-rugose, the pericarp rather thick, almost woody, reported to ripen yellow. Seeds about sixty, embedded in a white pulp.

COLOMBIA: Intendencia del Meta, Cordillera La Macarena, trocha entre el Río Güejar y el Caño Guapayita. Alt. ca. 500–600 m. "Small tree, 12 feet tall. Fruit with soft velvety indumentum, ribs bluntly rounded, unequal." January 22, 1951. *Jesús M. Idrobo and Richard Evans Schultes 1192* (TYPE in Herb. Gray; DUPLICATE TYPE in Herb. Nac. Colomb.).—Intendencia del Meta, Sabanas de San Juan de Arama, márgen izquierda del Río Güejar, alrededores del aterrizaje "Los Micos." Alt. ca. 500 m. "Small tree. All parts of flowers deep scarlet." March 15, 1951, *Richard Evans Schultes 11821* (FLORAL TYPE in Herb. Gray).—Intendencia del Meta, Villavicencio. Alt. 300 m. "*Cacaoito de monte.*" 1851–1857, *J. Triana s.n.*—Intendencia del Meta, Villavicencio. January 24, 1899, *T. A. Sprague 135.*—No precise locality. "Colombia." February 1899, *Rocha s.n.*—Intendencia del Meta, forest near Villavicencio. February 1943, *M. Bates s.n.*—Intendencia del Meta, Sierra de La Macarena. Playa Bonita. Alt. 400 m. "Dense, humid forest. Erect shrub." November 14, 1947, *W. R. Philipson, J. M. Idrobo & A. Fernández 1420.*—Intendencia del Meta, Sierra de La Macarena, Caño Entrada. Alt. 550 m. "Dense, humid forest. Unbranched slender tree, 8 m. high; fruits green." January 22, 1950, *W. R. Philipson, J. M. Idrobo & R. Jaramillo 2199.*—Intendencia del Meta, Sabanas de San Juan de Arama, márgen izquierda del Río Güejar, alrededores del aterrizaje "Los Micos." Alt. ca. 500 m. "Small tree, 12 feet tall." December 9, 1950, *Jesús M. Idrobo & Richard Evans Schultes 612.*—Same locality. "Arbolito de 2 m. Frutos caulinares." December 18, 1950, *Jesús M. Idrobo & Richard Evans Schultes 721.*—Intendencia del Meta, Cordillera La Macarena, trocha entre el Río Güejar y el Caño Guapayita. Alt. ca. 500–600 m. "Foliolos muy largos, pubescentes. Pequeño arbolito de 3.5 m." December 24, 1950, *Jesús M. Idrobo & Richard Evans Schultes 787.*—Intendencia del Meta, Cordillera La Macarena, trocha entre el Río Güejar y el Caño Guapayita, Caño Yerly. "Fruit dull green." March 9, 1951, *Richard Evans Schultes 11629.*

*Herrania tomentella* resembles, in its foliage, *H. pul-*

*cherrima* and *H. Cuatrecasana*. It differs from the former in having a much more finely sinuate margin, in having a smooth (instead of a rather muricate-subtuberculate) upper surface, in being more finely tomentose beneath, and in being membranaceous (rather than coriaceous) and generally smaller. From the latter, it can be distinguished by differences in the shape and margin of the leaflets. *Herrania Cuatrecasana* is conspicuously and gradually decurrent towards the base and has a very remotely and obscurely crenate-denticulate margin.

In the form of its fruit, *Herrania tomentella* approaches *H. Cuatrecasana* more closely than *H. pulcherrima*. The capsule of *Herrania pulcherrima* has strongly cultriform ribs with stinging hairs, whereas that of *H. tomentella* has broadly rounded ribs without stinging hairs. Furthermore, floral differences between *H. pulcherrima* and *H. tomentella* are marked, especially in the staminodes, which are apically trifid in the former but acute in the latter.

Although there are a number of resemblances between the capsules of *Herrania tomentella* and *H. Cuatrecasana*, the soft indumentum and lack of stinging hairs in the former are in sharp contrast to the condition in the latter where, except for stinging hairs along the ribs, the surface is glabrous or glabrescent. There are likewise several floral differences.

The leaflets of *Herrania tomentella* are borne in a partly erect position. This is also true of *Herrania Cuatrecasana* and *H. pulcherrima* and possibly of all species which have a noticeably swollen callus at the base of the leaflets. In this erect position of the leaflets, *Herrania tomentella* differs strikingly in habit from the only other species known in the Macarena, *H. nitida*, which has leaflets which tend to be rather reclinate.

A study of the fruit of the material from the Macarena has clarified a confusion of long standing. Although

specimens of *Herrania tomentella* have, in the past, been referred to *H. pulcherrima* or to *H. nitida* (as *H. nitida* var. *aspera*), a study of the capsule, until recently unknown, shows conclusively that *H. tomentella* has its relationships in other directions.

## Guttiferae

**Clusia chiribiquetensis** *Maguire ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 15 (1951) 56, Pl. XVIII, upp. fig.

We now publish a drawing (Pl. XXXIII) of the type specimen of this interesting endemic *Clusia*.

**Clusia Schultesii** *Maguire ex Schultes* in Bot. Mus. Leafl. Harvard Univ. 15 (1951) 65.

*Clusia Schultesii* was not figured when it was described, but the concept is of such phytogeographical interest that the accompanying plate (XXXIV) is now offered.

## Lythraceae

(Contributed by Dr. Alicia Lourteig)

**Cuphea sunubana** *Lourteig sp. nov.*

Suffrutex (alt. ignota), ramis sublignosis, profuse ramificatis, flavo- vel ferrugineo-setosis (setis basi incrassatis, adpresso-adscendentibus) et minutissime pubescentibus, glabrescentibus. Internodia 4–6 mm. longa, quam folia minora. Folia decussata, subsessilia, conferta, discoloria, lanceolata (10–20×1.5–5 mm.), acuta, margine reflexa, nervo centrali rubente, subtus conspicuo, nervis secundariis plusminusve conspicuis, subtus setis in nervis atque marginem versus sed supra rarius in nervo centrali atque in lamina sparsis. Flores alterni inter folia. Pedunculi 3–5 mm. longi, tenues, setosi, apicem versus bibracteolati. Bracteolae ovato-acuminatae, plusminusve pubescentes. Calyx 5.5–6.5 mm. longus, fauce paulo dilatatus,

calcare recto, nervis copiosissime setosis (setis illis ramorum similibus) atque minutissime pubescentibus in lobulis appendicibusque, illo sub staminibus interne pubescente sed ceterum glabro. Petala sex, lilacea, obovato-subspathulata, 4–5×2–2.5 mm. Stamina 11, prope partem centralem calycis inserta, duo dorsalia brevissima, alia longiora, horum tria ventralia glabra cetera pubescentia. Ovarium oblongum, in stylum inclusum, minute pubescentem attenuatum. Stigma capitatum. Ovulum carnosum, grossum, subhorizontale. Semen immaturum suborbiculare, complanatum, caruncula tum, marginatum, minute foveolatum.

It is unfortunate that no mature seeds are available for this species, for it is difficult to place the concept, which is quite distinct, in any section of the genus. I believe, nevertheless, that it belongs to Sect. 5 *Brachyandra*, Subsect. 2 *Melanium*, Ser. 3 in Koehne's system (in Engler Pflanzenr. IV. 216 (1903) 82). It would fall between *Cuphea ciliata* Ruíz & Pav. (*C. microphylla* HBK.) and *C. fuscinervis* Koehne. From the former, it differs in its inflorescence and pubescence and in having a red median nerve; from the latter, a Brazilian species, in its simple inflorescence.

The specific epithet refers to the locality where the type was taken—the Río Súnuba.

Colombia: Departamento de Boyacá, Cordillera Oriental, vertiente oriental. Entre Gueteque y Guayatá, márgenes del Río Súnuba. Alt. 1500 m. June 30, 1940, *J. Cuatrecasas 9698* (Type in Herb. Field Mus.).

The other new species of *Cuphea* herewith described belong in Section 6: *Euandra*, Subsection 2: *Hyssopocuphea* in Koehne's System.

It is regrettable that in almost all of the material available to me the seeds are immature. My studies, however, indicate that it is very probable that they would

not measure more than 2 mm. at maturity, a character used in Koehne's key to the Subsections.

The appearance of the seeds, as well as the general characters of the plants and their malpighiaceous type of pubescence, agrees with those for Section *Hyssopocuphea*.

As no species of this group has previously been recorded from Colombia, it would seem to be of interest to give a key for these five species.

Stems and branches only malpighiaceous-pubescent.
  Calyx only malpighiaceous-pubescent. Ovules 2–4.
    Seeds usually 3 . . . . . *kubeorum*
  Calyx malpighiaceous and setaceous-pubescent.
    Ovules 5–6 . . . . . *stygialis*
Stems and branches with another type of pubescence intermixed with the malpighiaceous.
  Calyx-appendage long-setaceous. Ovules 12–15 . *philombria*
  Calyx-appendage short-ciliate or glabrous.
    Ovary glabrous with sparse short hairs.
      Disk deflected, narrowly triangular.
        Ovules 10–12 . . . . . *sucumbiensis*
      Ovary densely pubescent. Disk reflexed, ovoid-complanate. Ovules 4–6 . . . . . *beneradicata*

**Cuphea kubeorum** *Lourteig sp. nov.*

Suffrutex usque ad 1½ pedes altus, carnoso-malpighiaceo-pubescens (pilorum brachiis in angulo acuto, hirsutis), plusminusve glabrescens. Rhizoma cylindricum, quam 20 cm. longius, cum ramulis fibrosis. Caulis basis sublignosa, crassa, brevis, e superficie terrae in caules secundarios numerosos divisa. Caules tenues, decumbentes, usque ad 20 cm. longi. Internodia variabilia, 3 mm. usque ad 2 cm. longa. Folia vulgo conferta, decussata, discoloria, parva, linealia, usque ad 8×1 mm., obtusa, supra pubescentia, subtus glabra, subsessilia cum petiolis brevissimis et angustissimis, margine reflexa, nervo centrali lato supra impresso sed subtus conspicue elevato. Flores alterni vel decussati. Pedunculi plerumque infrapetiolares, plusminusve 2 mm. longi, bibracteolati. Bracteolae

ovatae, pubescentes, plusminusve 0.3 mm. longae. Calyx 4.5 mm. longus, parte mediana constrictus, fauce dilatatus, cum calcare conspicuo, oblique incurvato, obtuso; lobulis latis, acuminatis; appendicibus quam lobulis minoribus, inerassatis; pilis malpighiaceis, uniformibus, brevibus; intus in nervis dense pubescens, sub staminibus lanosus. Petala sex, violacea, elliptica vel oblonga, 2–2.5 ×0.25–1 mm., obtusa. Stamina 11, inclusa, duo dorsalia brevissima, alia paulo majora, maturitate vulgo calycis marginem attingentia, horum tria ventralia glabra cetera lanosa. Ovarium asymmetrico-semiovoideum, dense pubescens, in stylum tenuem, inclusum, pubescentem attenuatum. Stigma capitatum. Discus crassus, deflexus, latus, obtusus. Ovula 2–4. Semina vulgo tria (non matura), suborbicularia, complanata, plusminusve 1.5 mm., leviter marginata, minute foveolata.

The specific epithet has reference to the Kubeo Indians who inhabit the general area where *Cuphea kubeorum* is known to grow.

Colombia: Comisaría del Vaupés, Río Kubiyú (tributary of Río Vaupés), Cerro Kañendá, savannahs about 15 miles upstream from mouth. Quartzite base. Alt. about 800–900 feet. November 10, 1952, *Richard Evans Schultes & Isidoro Cabrera 18306* (Type in Herb. Gray). —Comisaría del Vaupés, Río Paraná Pichuna (tributary of Río Vaupés). Alt. about 700 feet. General location: Lat. 1°10′ N, Long. 70°30′ W. June 1953, *Richard Evans Schultes & Isidoro Cabrera 19913*.

**Cuphea stygialis** *Lourteig sp. nov.*

Suffrutex usque ad pedem altus. Planta omnino aequaliter adpresso-malpighiaceo-pubescens, pilis crassis, albocerosis cum fundamento brevi et ramis inaequalibus rigidis. Rhizoma tortuosum, cylindricum, usque ad plusminusve 20 cm. longum, 8 mm. in diametro, cum ramis longis fibrosisque. Caules e basi in ramos divisi, recti vel aliquid decumbentes, basi usque ad 4 mm. Internodia quam folia minora, 4–8 mm. Folia decussata, rarenter verticillata (3 in verticillo), discoloria, lanceolata vel line-

alia, 8–18×1.5–3 mm., subsessilia, obtusa, marginata, nervo centrali fusco utrinque conspicuo, subtus cum pilis sparsis sed ceterum glabro. Flores alterni vel decussati, inter folia. Pedunculi 2–4.5 mm. longi, apicem versus bibracteolati. Bracteolae crassae, ovatae vel oblongae. Calyx 4.5–5.5 mm. longus, fauce dilatatus, calcare incurvato, lobulis triangulari-acuminatis, brevissime ciliatis, appendicibus crassis, quam lobulis brevioribus, dense adpresso-malpighiaceo-pubescentibus et hispido-fusco-glandulosis in parte mediana inferiore; intus dense pubescens. Petala sex, alba et purpureo-striata, obovato-subspathulata, 2.5–2.6×1.5–1.75 mm., obtusa. Stamina 11, inclusa, duo dorsalia brevissima, alia paulo majora, horum tria ventralia glabra, cetera lanosa. Pistillum inclusum, plusminusve 3 mm. longum. Ovarium dense pilosum, semiovoideum, in stylum pilosum attenuatum. Stigma capitatum. Ovula 5–6. Discus crassus, deflexus, complanato-ovoideus. Semina parva, 1–1.5 m., suborbicularia, plano-convexa, minutissime foveolata, caruncula conspicua.

*Cuphea stygialis* grows in dense carpets along the very edge of the great waterfall, where it is constantly under a spray of moisture.

The specific epithet *stygialis* has been chosen because, according to Dr. Schultes, the Raudal de Jirijirimo is a sacred place to the Indians of the Río Apaporis, who believe that it is the home of the dead leaders of their tribes.

Colombia: Comisarías Amazonas-Vaupés, Río Apaporis, Raudal de Jirijirimo (below mouth of Río Kananarí). Quartzite base. Alt. about 900 feet. February 14, 1952, *Richard Evans Schultes & Isidoro Cabrera 15330* (Type in Herb. Gray).

**Cuphea philombria** *Lourteig sp. nov.*

Frutex plusminusve 50 cm. altus, pilis setosis malpighiaceisque obtectus. Radices fibrosae, profuse ramificatae,

usque ad 30 cm. longae. Caules basi sublignosi, 5 mm. in diametro, dichotome ramificati. Rami inaequales, rubicundulo-setosi et cano-malpighiaceo-pilosi. Internodia 0.5–1 mm. longa, quam folia breviora. Folia discoloria, lineari-lanceolata (15–30×4.5–8 mm.), sessilia vel subsessilia, petiolo crasso, uninervia, subtus cum pilis malpighiaceis et nervo conspicuo, supra leviter strigosa cum nervo aliquid impresso, apice acuta vel obtusa. Flores alterni vel rarenter decussati, inter folia. Pedunculi infrapetiolares, 4 mm. longi, tenues, pubescentes, apicem versus bibracteolati. Bracteolae crassae, parvae (circiter 0.5 mm. longae), suborbiculares, rubicundulae. Calyx atroviolaceus, a fauce longitudinis $\frac{1}{3}$ constrictus, fauce ampliata, viscido-setulosus (setis violaceis) atque cum pilis canis malpighiaceisque, calcare obliquo subacutoque; lobulis pubescentibus, inter sepala appendicibus subulatis, setosis, quam lobulis aliquid minoribus; intus ubique minute pubescens et parte superiore sub staminibus lanato-pubescens. Petala sex, violacea, obovato-cuneata (4.5–7×2.5–3.5 mm.), obtusa. Stamina 11: duo dorsalia brevissima, alia majora (sed calycem non excedentia), horum tria glabra, cetera pilosa. Discus carnosus, crassus, reflexus, obtusus. Ovarium asymmetrico-semiovoideum, plusminusve 5 mm. longum, breviter pubescens, in stylum inclusum attenuatum, plusminusve pilosum. Stigma subcapitatum, papillosum. Ovula 12–15. Semen castaneum, complanato-suborbiculare (circiter 1.5 mm. statu immaturo), minute foveolatum.

The specific epithet *philombria* is derived from the Greek meaning "lover of rain" and refers to the high rain-forest habitat where the plant grows abundantly along fast-running rills.

COLOMBIA: Intendencia del Meta, Cordillera La Macarena, Macizo Renjifo. Alt. 1,300–1,900 m. "On rocky banks at river's edge, roots imbedded in moss; in shaded, damp areas." January 20, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1062* (TYPE in Herb. Gray).—Same

locality. "On rocks, with roots imbedded in moss; very full, in clumps; in sunny spots." January 20, 1951, *Jesús M. Idrobo & Richard Evans Schultes 1061.*

**Cuphea sucumbiensis** *Lourteig sp. nov.*

Suffrutex (alt. ignota), omnino cano-malpighiaceo-pubescens, basi sublignosus, ramificatus. Rami tenues, setis ferrugineis, basi incrassatis, adscendentibus copiose obtecti. Internodia quam folia minora, 3 mm. longa. Folia decussata, conferta, sessilia vel subsessilia. Petioli lati, rubicunduli, setosi, ramis similes. Lamina linealis vel lineali-lanceolata, 5–14×0.6–2 mm., discolor, obtusa vel acuta, intus pubescentior, glabrescens, nervo centrali subtus prominenter elevato, fusca, setosa, margine reflexa. Flores decussati, alterni, apice ramorum inter folia positi. Pedunculi infrapetiolares, 2.5 mm. longi, pubescentes, ramis similes, partem centralem superiorem versus bibracteolati. Bracteolae crassae, ovatae, 0.5 mm. longae, obtusae. Calyx gracilis, 4–5 mm. longus, fauce dilatatus, calcare conspicue producto, lobulis acutis, appendicibus incrassatis, lobulis aequalibus vel paulo longioribus, adpresse cano-malpighiaceo-pubescentibus et inferne cum setis brevibus fuscis commixtis; intus in nervis dorsalibus pubescens et in ceteris plusminusve minute puberulentus, sub staminibus lanosus. Petala sex, lilacina, obovata vel oblonga, duo dorsalia aliquid majora, 2.5–2.75 ×1–2 mm. Stamina 11, in parte mediana superiore calycis inserta, inclusa, duo dorsalia brevissima, alia majora, horum tria ventralia glabra, cetera plusminusve grosse pilosa. Ovarium asymmetrico-ovoideum, glabrum vel pilis brevibus sparse ornatum. Stylus tenuis, inclusus, plusminusve pubescens. Stigma subcapitatum. Ovula 10–12. Discus magnus, 0.5–0.6 mm., triangulari-cordiformis, complanatus, abrupte deflexus. Semina (immatura) parva, suborbicularia, complanata, paulo marginata, minute foveolata.

*Cuphea sucumbiensis* is named for the type locality, the Río Sucumbíos, which forms part of the boundary between Colombia and Ecuador. The species should be recorded also for the flora of Ecuador, for, doubtless, it occurs on both banks of this river.

COLOMBIA: Comisaría del Putumayo, frontera Colombo-ecuatoriana. Selva higrófila del Río Sucumbíos (San Miguel), entre los afluentes Conejo y Hormiga. Alt. 300 m. December 15, 1940, *J. Cuatrecasas 11069a* (TYPE in Herb. Field Mus.).

**Cuphea beneradicata** *Lourteig sp. nov.*

Suffrutex 20–25 cm. altus, basi lignosus, crassus, tortuosus, in saxorum fissuris crescens, cano-malpighiaceo-pubescens et in caulibus juvenilibus etiam cum pilis purpureo-hispido-glandulosis. Internodia quam folia minora, 2–4 mm. longa. Folia lanceolata vel linealia, obtusa, margine reflexa, 8–11×1–3 mm., subsessilia, petiolis crassis, plusminusve 0.6 mm. longis, nervo centrali lato, fusco, infra conspicuo, subtus densius adpresso-cana, malpighiaceo-pubescentia et margine (statu juvenili) cum ciliis longis, tenuibus et glandulosis, caducis. Flores decussati, in ramorum apice. Pedunculi 2–2.5 mm. longi, in parte mediana superiore bibracteolati. Bracteolae ovato-acuminatae, 0.5 mm. longae, pubescentes. Calyx 5–5.5 mm. longus, malpighiaceo-pilosus (pilis plusminusve hirsutis) et copiose purpureo-hispido-glandulosus in parte inferiore; lobulis latis, acuminatis; appendicibus crassis, pubescentibus, lobulis aequalibus; calcare conspicuo incurvato, obtuso; intus in nervis pubescens, sub staminibus lanosus. Petala sex, roseo-purpurea, 3.5×1.5 mm., oblonga vel obovato-oblonga. Stamina 11, duo dorsalia brevissima, alia majora, calycis marginem attingentia, horum tria ventralia glabra, cetera lanosa. Pistillum 3.5 mm. longum, inclusum. Ovarium asymmetrico-semiovoideum, dense pubescens. Pistillum tenue, pubescens. Stigma subcapitatum. Discus complanato-ovoid-

eus, deflexus, obtusus. Ovula 4–6. Semina adhuc ignota.

I have chosen the specific epithet because, according to the three collectors of the material cited below, this little shrub is anchored so firmly by its fibrous roots in the cracks of the bare sandstone where it grows that it could not be collected with the roots but had to be cut off at the surface of the ground.

COLOMBIA: Comisaría del Vaupés, Mesa La Lindosa, 15–20 km. de San José del Guaviare. Alt. 400–600 m. December 13–15, 1950, *Jesús M. Idrobo & Richard Evans Schultes 640* (TYPE in Herb. Gray).—Comisaría del Vaupés, San José del Guaviare. Alt. 270 m. November 12, 1939, *J. Cuatrecasas 7691*.

**Cuphea annulata** *Koehne* in Martius Fl. Bras. 13, pt. 2 (1877) 304, t. 56, f. 5.

Although the type of this species bears a label reporting the "calyx coccineus," and the collection cited below states "flowers basally green-yellow, remainder (about ¾ of length) red," their identity is unquestionable.

The petals and stamens are red. The ovules are five, reducing to two or three seeds at maturity. As Koehne did not see the seeds, having only the type material, it seems to me advisable to describe them:

Seeds dark brown, complanate-suborbiculate (± 3 mm.), slightly marginate, border somewhat concave at the place of the caruncle, apex broadly retuse, surface finely foveolate.

The type of *Cuphea annulata* was collected in 1820 by Martius at Araracuara on the Río Caquetá in Colombia, not from Brazil nor from the Río Negro as stated on the label: "Alto Amazonas, Río Negro bei Araracoara." It is of interest to note that the locality of *Schultes & Cabrera 17509* is an isolated mountain not far in a straight line from Araracuara and belonging geologically to the same formation. The species is one of the characteristic endemics of the ancient cretaceous sandstone Venezuela-

Guiana land-mass and has recently turned up on Cerro Duida, as I shall point out in detail in another paper.

Colombia: Comisaría del Vaupés, Río Piraparaná (tributary of Río Apaporis), Cerro E-ree-kŏ-mee-ŏ-kee. General location: between Lat. 0°15′ S, Long. 70°30′ W and Lat. 0°25′ N, Long. 70°30′ W. "Somewhat scandent shrub 4 feet tall. Flowers basally green-yellow, remainder (about $\frac{3}{4}$ of length) red. Leaves very bright green." September 18, 1952, *Richard Evans Schultes & Isidoro Cabrera 17509*.

## Apocynaceae

**Couma catingae** *Ducke* in Archivos Inst. Biol. Veg. Rio Janeiro 4 (1938) 59.

The collection cited below extends the range of this species, hitherto reported only from the Amazonas of Brazil, into Colombia.

Colombia: Comisarías del Amazonas-Vaupés, Río Apaporis, Cachivera de Jirijirimo y alrededores. Alt. c. 250 m. "Small caatinga tree. Latex white. Puinave = *hwãn-hwãn*." June 13, 1951, *Richard Evans Schultes & Isidoro Cabrera 12461*.

# ILLUSTRATIONS

## EXPLANATION OF THE ILLUSTRATION

PLATE XXII. ANTHURIUM ATROPURPUREUM *Schultes & Maguire.* 1, habit, one third natural size.

ANTHURIUM NEMORICOLA *Schultes & Maguire.* 2, habit, one half natural size. 3, 4, 5, leaves, one half natural size.

*Drawn by* DOROTHY H. MARSH

# ANTHURIUM
## *atropurpureum*
*Schultes et Maguire*

1

2

3

4

5

D.H.M.

# ANTHURIUM
## *nemoricola*
*Schultes et Maguire*

## EXPLANATION OF THE ILLUSTRATION

PLATE XXIII. The type plant of PAEPALANTHUS MOLDENKEANUS *R. E. Schultes*. Río Kuduyarí, Yapobodá, Comisaría del Vaupés, Colombia.

*Photograph by* RICHARD EVANS SCHULTES

# Plate XXIII

## EXPLANATION OF THE ILLUSTRATION

PLATE XXIV. (*Top*) Habitat of PAEPALANTHUS MOLDENKEANUS *R. E. Schultes* showing, at the right of the *Paepalanthus*, two shrubs of VELLOZIA LITHOPHILA *R. E. Schultes*, Río Kubiyú, Cerro Kañendá, Comisaría del Vaupés, Colombia.

(*Bottom*) Habit of THURNIA SPHAEROCEPHALA (*Rudge*) *Hook.f.* in Caño Paca, Río Piraparaná, Comisaría del Vaupés, Colombia.

*Photographs by* RICHARD EVANS SCHULTES

# Plate XXIV

## EXPLANATION OF THE ILLUSTRATION

PLATE XXV. PITCAIRNIA MACARENENSIS *L. B. Smith.* 1, habit, one twentieth natural size. 2, floral bract and flower, natural size. 3, sepal, natural size. 4, base of petal, natural size.

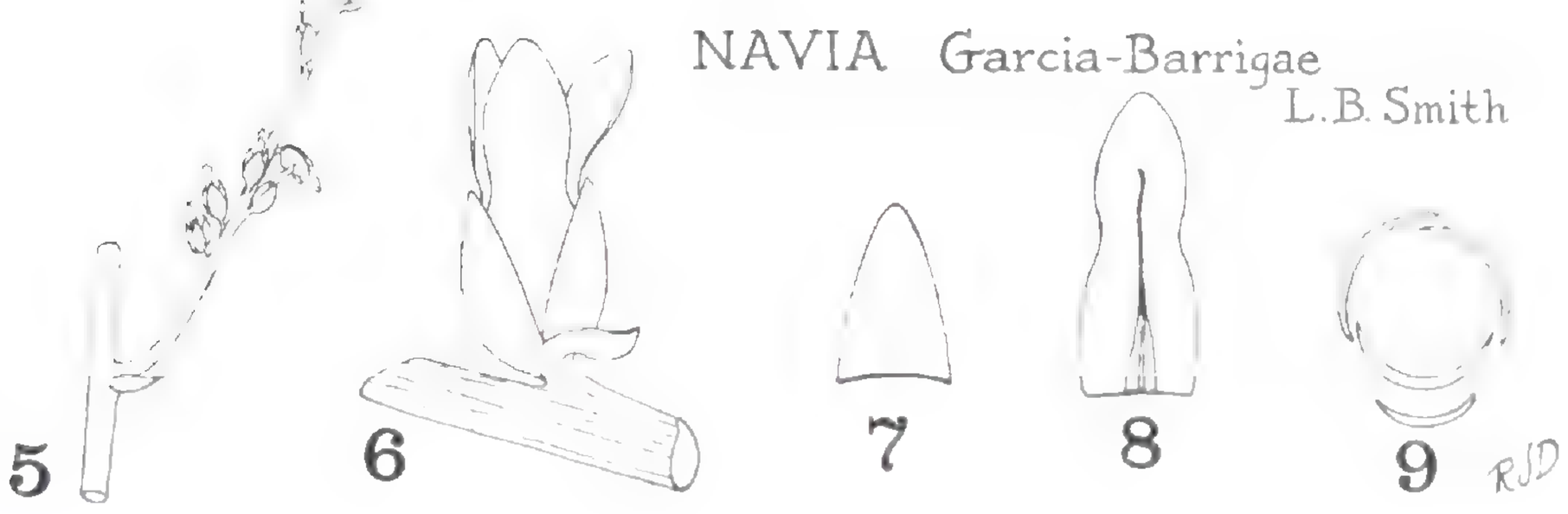
NAVIA GARCIA-BARRIGAE *L. B. Smith.* 5, branch of inflorescence, natural size. 6, floral bract and flower, five times natural size. 7, sepal, five times natural size. 8, petal and filament, five times natural size. 9, diagrammatic cross-section of floral bract and sepals, five time natural size.

*Drawn by* ROBERT J. DOWNS

# Plate XXV

PITCAIRNIA
macarenensis
L. B. Smith

NAVIA Garcia-Barrigae
L. B. Smith



## EXPLANATION OF THE ILLUSTRATION

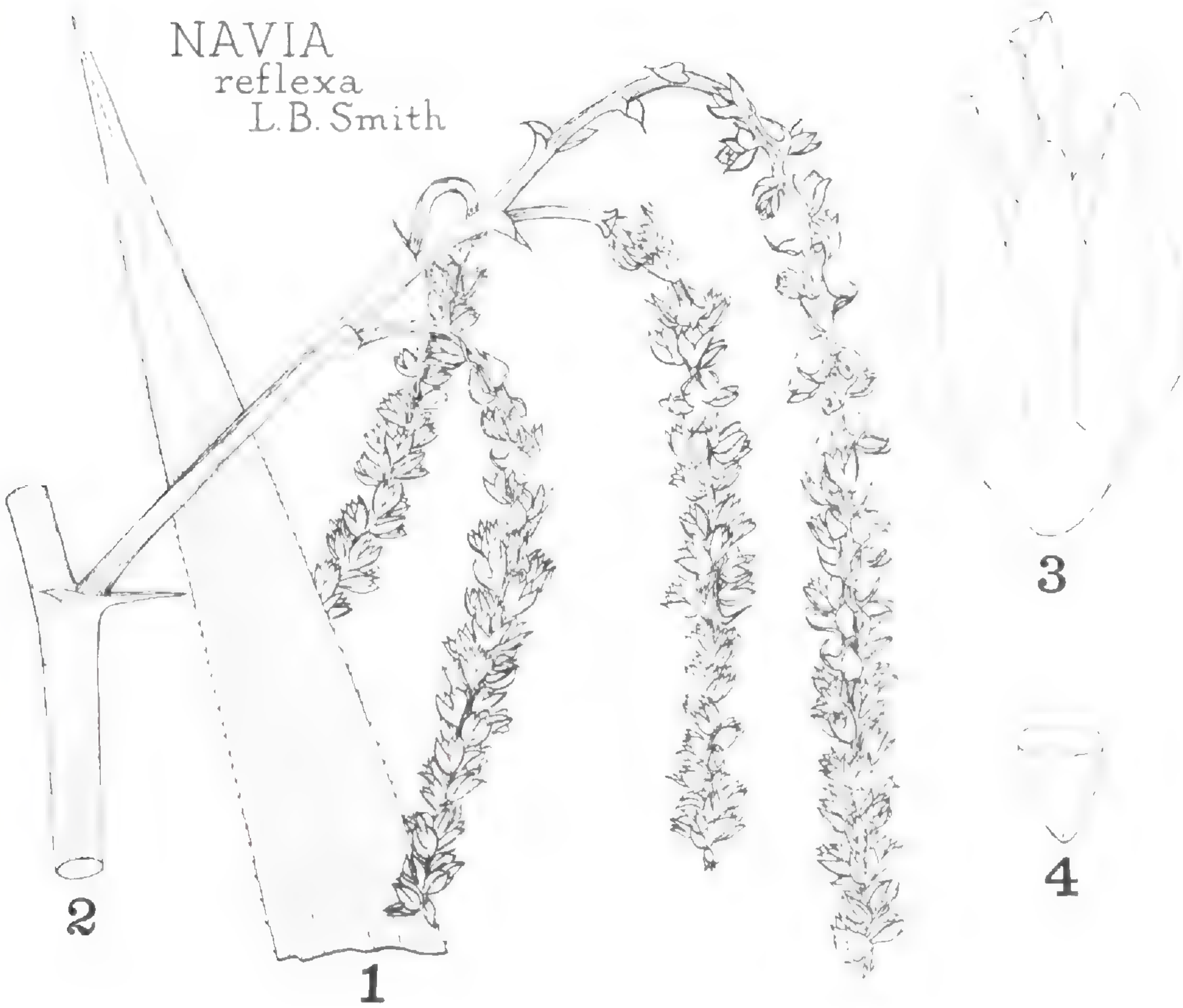
PLATE XXVI. NAVIA REFLEXA *L.B.Smith*. 1, apex of leaf, one half natural size. 2, branch of inflorescence, one half natural size. 3, anterior view of flower, five times natural size. 4, seed, five times natural size.

NAVIA HELIOPHILA *L.B.Smith*. 5, apex of leaf, natural size. 6, margin of leaf, five times natural size. 7, floral bract and flower, natural size. 8, posterior view of flower, five times natural size.

*Drawn by* ROBERT J. DOWNS

# Plate XXVI

NAVIA
reflexa
L.B. Smith



1

2

3

4

NAVIA
heliophila
L.B. Smith

5

6

7

8

## EXPLANATION OF THE ILLUSTRATION

PLATE XXVII. Habitat of NAVIA HELIOPHILA *L. B. Smith* at Raudal de Jirijirimo, Río Apaporis, Comisaría del Amazonas, Colombia.

*Photograph by* RICHARD EVANS SCHULTES

# Plate XXVII

## EXPLANATION OF THE ILLUSTRATION

PLATE XXVIII. NAVIA LOPEZII *L. B. Smith*. 1, habit, about one half natural size. 2, flower, natural size. 3, schematic cross section of flower, about one and one half times natural size.

NAVIA MYRIANTHA *L. B. Smith*. 1, habit, about one half natural size. 2, flower, five times natural size. 3, schematic cross section of flower, about ten times natural size.

*Drawn by* ELMER W. SMITH

NAVIA Lopezii
L.B.Smith
3
1
2
E.W.Smith
2
3
1
NAVIA myriantha
L.B.Smith

## EXPLANATION OF THE ILLUSTRATION

PLATE XXIX. VELLOZIA MAUDEANA *R. E. Schultes* in flower and fruit. Goo-rán-hoo-da, Río Karurú, Comisaría del Vaupés, Colombia.

*Photograph by* RICHARD EVANS SCHULTES

# Plate XXIX

## EXPLANATION OF THE ILLUSTRATION

PLATE XXX. (*Top*) Habit of VELLOZIA MAUDEANA *R. E. Schultes* at Goo-rán-hoo-da, Río Karurú, Comisaría del Vaupés, Colombia.

(*Bottom*) Habit of TETRAPTERIA METHYSTICA *R. E. Schultes* at Porto Makús, Río Tikié, Estado do Amazonas, Brazil.

*Photographs by* RICHARD EVANS SCHULTES

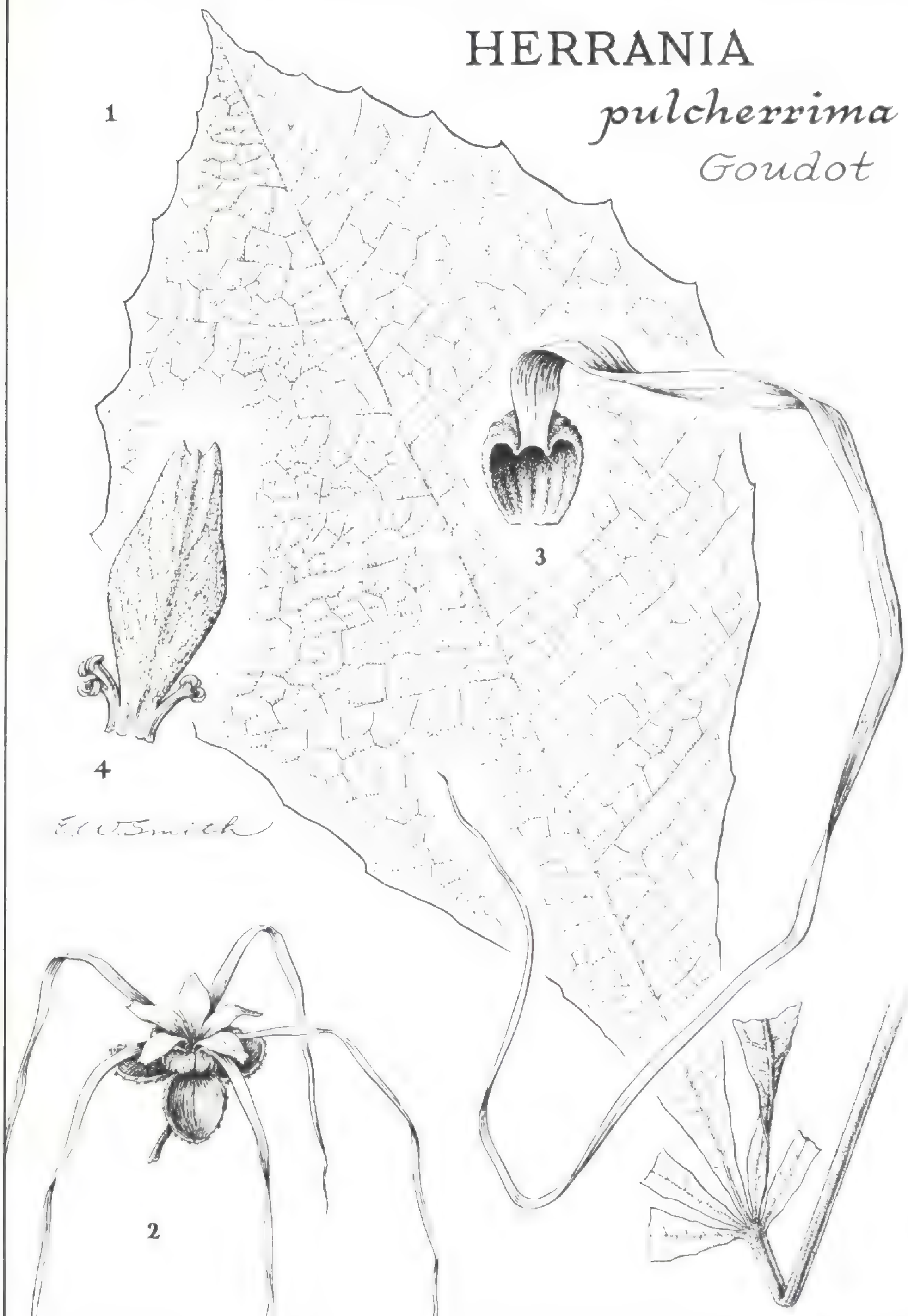
# Plate XXX

## EXPLANATION OF THE ILLUSTRATION

PLATE XXXI. HERRANIA PULCHERRIMA *Goudot*. 1, leaf, about one quarter natural size. 2, flower, one half natural size. 3, petal, twice natural size. 4, staminode and anthers, twice natural size.

*Drawn by* ELMER W. SMITH

PLATE XXXI



## EXPLANATION OF THE ILLUSTRATION

PLATE XXXII. (*Top*) Buds of HERRANIA TOMENTELLA *R. E. Schultes*. Cordillera La Macarena, Intendencia del Meta, Colombia.

(*Bottom*) Fruit of HERRANIA TOMENTELLA *R. E. Schultes*. Cordillera La Macarena, Intendencia del Meta, Colombia.

*Photographs by* RICHARD EVANS SCHULTES

# Plate XXXII

## EXPLANATION OF THE ILLUSTRATION

PLATE XXXIII. CLUSIA CHIRIBIQUETENSIS *Maguire*. 1, habit, one half natural size. 2, fruit, one half natural size. 3, flower, slightly less than natural size. 4, anther, about six times natural size.

*Drawn by* ELMER W. SMITH

# CLUSIA

## *chiribiquetensis Maguire*

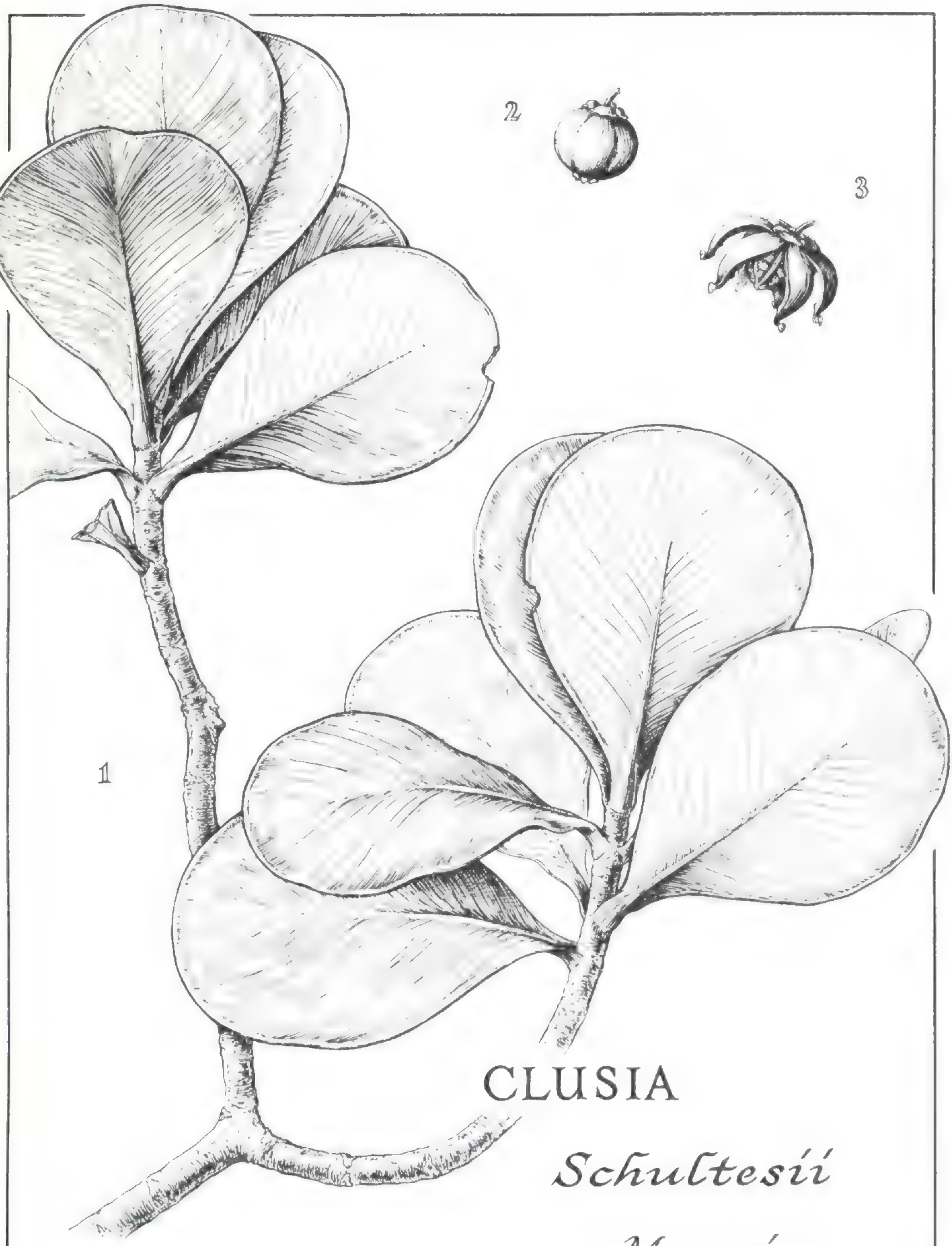
B.W. Smith

## EXPLANATION OF THE ILLUSTRATION

PLATE XXXIV. CLUSIA SCHULTESII *Maguire*. 1, habit, one half natural size. 2, fruit, closed, one half natural size. 3, fruit, opened, one half natural size.

*Drawn by* ELMER W. SMITH

PLATE XXXIV




# CLUSIA

## *Schultesii*

## *Maguire*

E.W. Smith

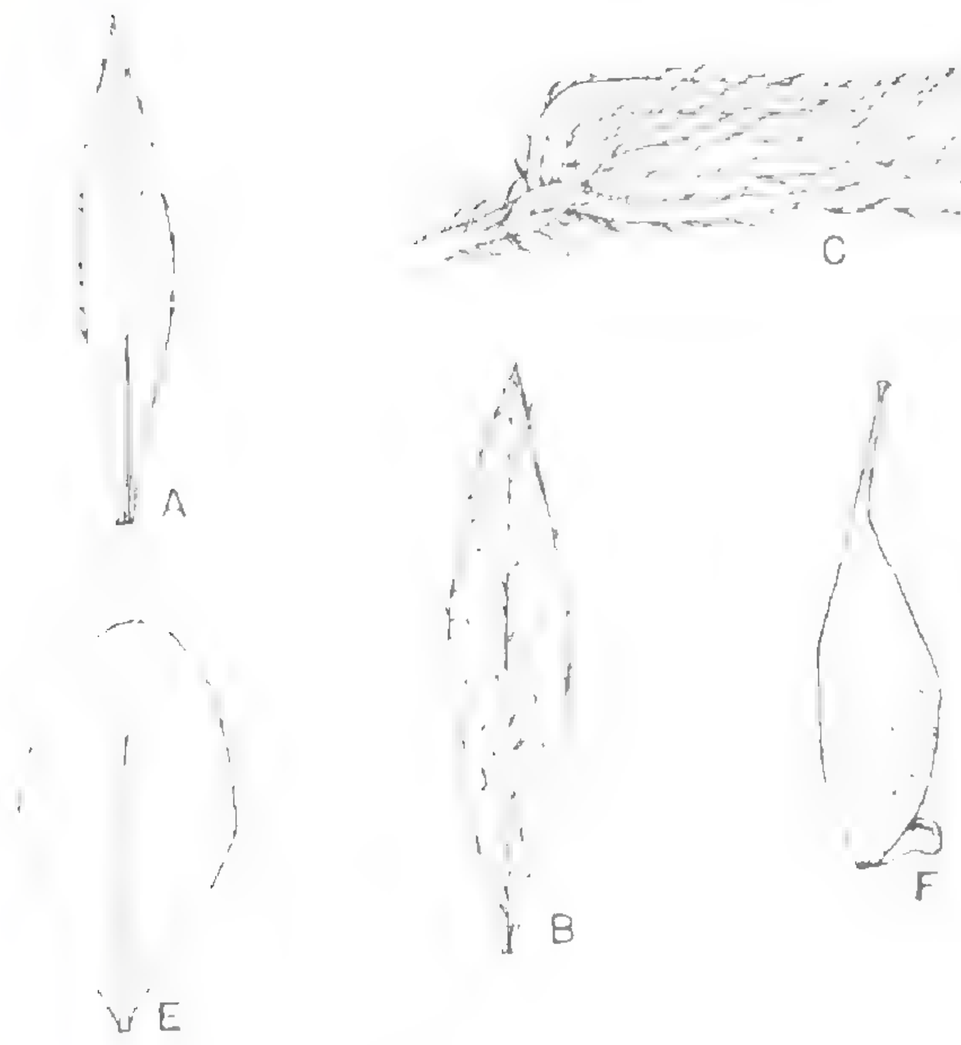
## EXPLANATION OF THE ILLUSTRATION

PLATE XXXV. CUPHEA SUNUBANA *Lourteig*. A, leaf, upper surface, twice natural size. B, leaf, lower surface, twice natural size. C, calyx, about four and one half times natural size. D, calyx, opened, five times natural size. E, petal, five times natural size. F, pistil, with disk, five times natural size. G, disk, seven times natural size. H, H[1], seed, five times natural size. Drawn from the type specimen.

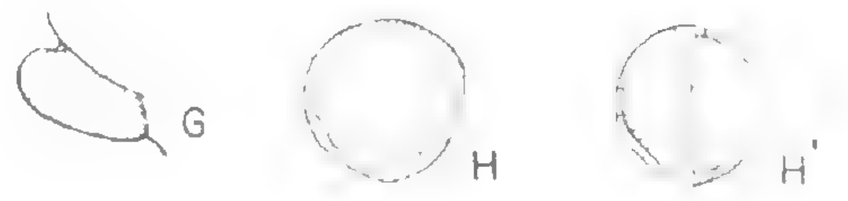
CUPHEA KUBEORUM *Lourteig*. A, calyx, six times natural size. B, calyx opened, seven times natural size. C, dorsal petal, seven times natural size. C[1], ventral petal, seven times natural size. D, pistil with disk, seven times natural size. E, disk, ten times natural size. Drawn from the type specimen.

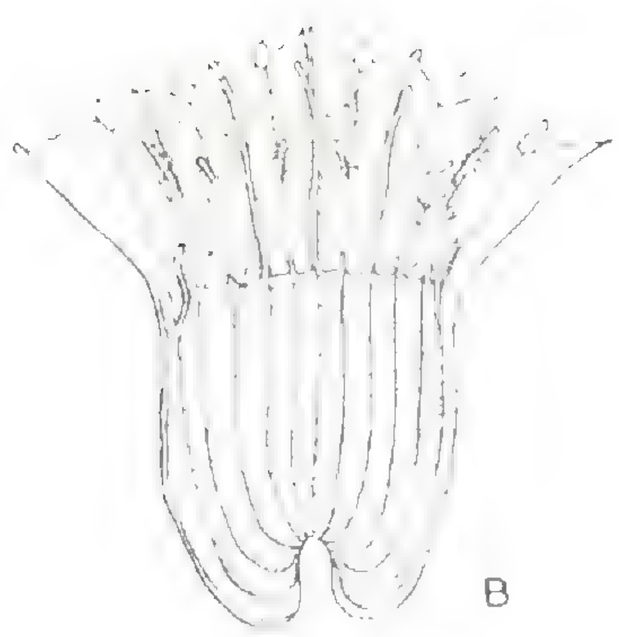
*Drawn by* ALICIA LOURTEIG

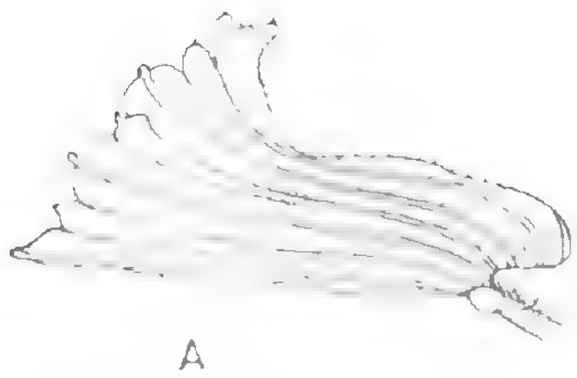
# Plate XXXV




CUPHEA
sunubana Lourteig






CUPHEA
kubeorum Lourteig

Lourteig del.

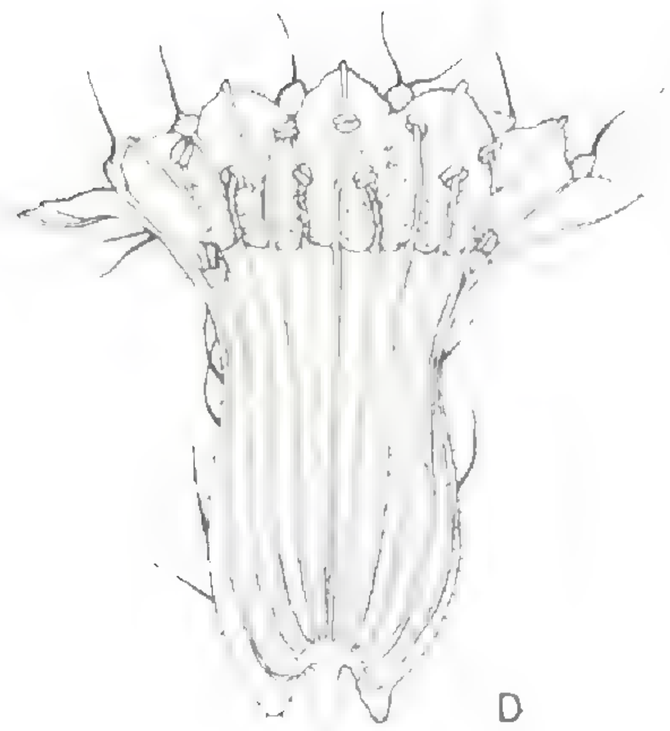
## EXPLANATION OF THE ILLUSTRATION

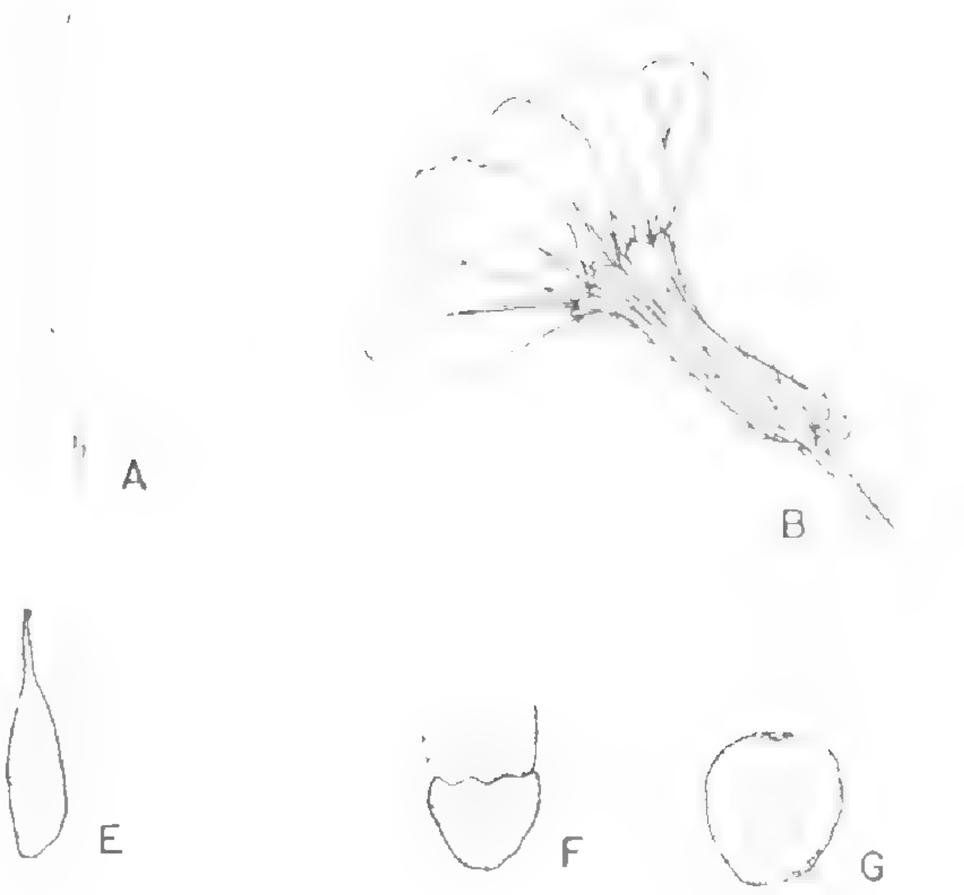
PLATE XXXVI. CUPHEA PHILOMBRIA *Lourteig*. A, leaf, twice natural size. B, flower, twice natural size. C, calyx, four times natural size. D, calyx, opened, four times natural size. E, pistil, four times natural size. F, disk, ten times natural size. G, seed, five times natural size. Drawn from the type specimen.

CUPHEA SUCUMBIENSIS *Lourteig*. A, leaf, lower surface, three times natural size. B, calyx, five times natural size. C, calyx, opened, with petals, five times natural size. D, pistil, with disk, five times natural size. E, disk, ten times natural size. Drawn from the type specimen.

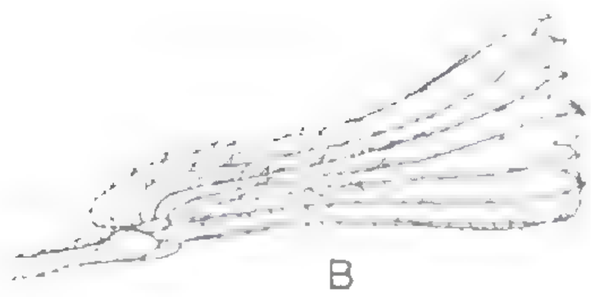
*Drawn by* ALICIA LOURTEIG

# Plate XXXVI




CUPHEA
philombria
Lourteig




CUPHEA
sucumbiensis
Lourteig

Lourteig del

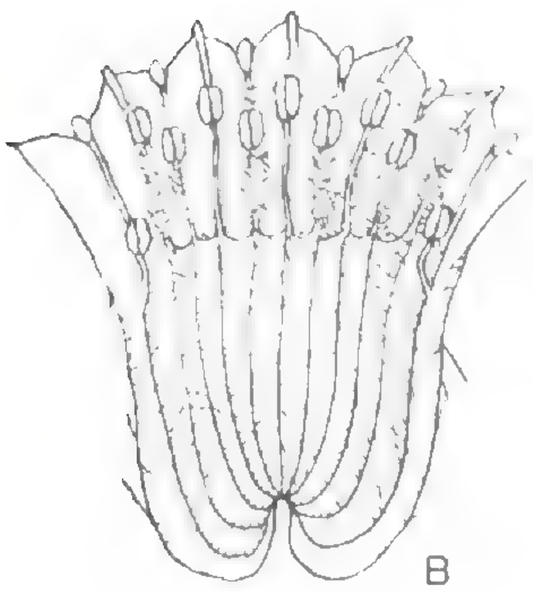
## EXPLANATION OF THE ILLUSTRATION

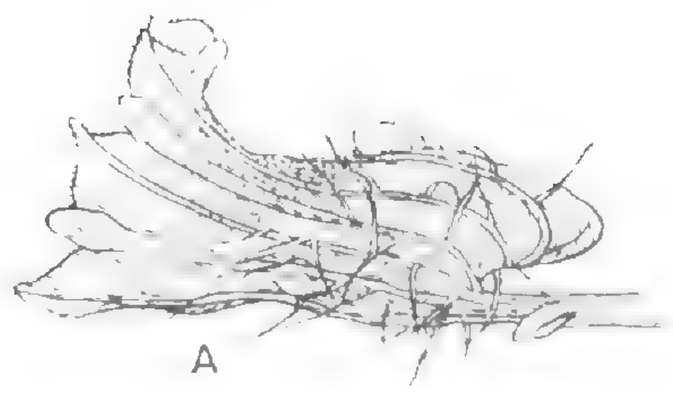
PLATE XXXVII. CUPHEA STYGIALIS *Lourteig*. A, calyx, five times natural size. B, calyx, opened, five times natural size. C, petal, five times natural size. D, pistil with disk, five times natural size. E, disk, ten times natural size. Drawn from the type specimen.

CUPHEA BENERADICATA *Lourteig*. A, young leaf, six times natural size. B, calyx, six times natural size. C, calyx, opened, six times natural size. D, petal, six times natural size. E, pistil with disk, six times natural size. F, disk, ten times natural size. Drawn from the type specimen.

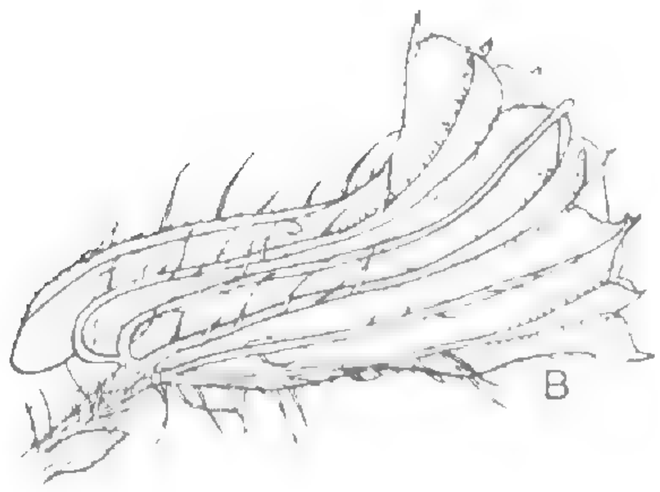
*Drawn by* ALICIA LOURTEIG

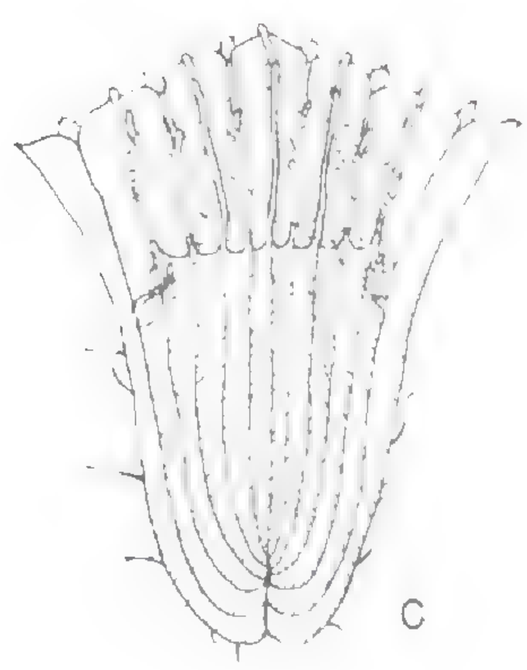
# Plate XXXVII



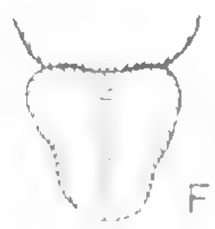




CUPHEA
stygialis
Lourteig




CUPHEA
beneradicata
Lourteig




Lourteig del.

# BOTANICAL MUSEUM LEAFLETS
## HARVARD UNIVERSITY

CAMBRIDGE, MASSACHUSETTS, JULY 12, 1954 VOL. 16, NO. 9


# FOSSIL MAIZE FROM THE VALLEY OF MEXICO


BY

ELSO S. BARGHOORN[1], MARGARET K. WOLFE[2]
AND KATHRYN H. CLISBY[3]


WITHIN the past decade studies on the origin, antiquity and evolution of maize have received new stimulus from archaeological and palynological discoveries in the southwestern United States and Mexico (Deevey, 1944; Mangelsdorf and Smith, 1949). It now appears well established that a maize culture developed and flourished in the presently semi-arid basins of New Mexico during a period ranging from approximately 3600 B.C., or earlier (Libby, 1951), to approximately 1000 A.D. The morphologically primitive structure of this prehistoric corn, in contrast to its surprisingly recent geologic age, is strong presumptive evidence, though not necessarily proof, that maize originated in the New World and was here developed from its wild state by aboriginal migrants into the American subtropics.

Recently, additional paleontological evidence has been obtained from the Valley of Mexico which indicates a far greater antiquity for the existence of maize in the New World than has yet been revealed by archaeologi-


[1] Department of Biology, Harvard University.
[2] Radcliffe College.
[3] Department of Geology and Geography, Oberlin College.

cal discovery. The evidence has been secured from a series of deep cores taken in Mexico City, in connection with extensive studies of the sub-surface. These cores have been described in some detail by Sears (1952), and Sears and Clisby (1952).

In the course of analyzing the pollen contents of the cores, Mrs. Clisby observed several unusually large grass-pollen grains in sediments close to the 70 meter level in the Belles Artes boring. The size of the grains (75$\mu$ to 135$\mu$ by acetylation method) at first appeared to preclude the reasonable possibility that they were derived from native wild grasses then extant in the Valley of Mexico. However, careful study of these fossil pollen grains, including detailed comparison with material in the Harvard Pollen Collections and in the Botanical Museum, suggested three possibilities for their botanical affinity, viz: Tripsacum, Zea or Euchlaena (teosinte)—all of the tribe Tripsaceae. If the grains actually proved to be those of *Zea Mays*, as seems most probable on the basis of their size alone, they would extend the fossil record of Indian corn far beyond our presently known chronology for the existence and dispersal of this remarkable genus of the grasses.

In order to establish a critical basis for identification of the fossil pollen, an extensive study was made of the size-range exhibited by the pollen of various species of Tripsacum and by varieties of maize and teosinte. To sustain essential uniformity in the data, all preparations of both living and fossil grains were prepared by the same technique (modification of Erdtman, 1943), and permanent slides were prepared with glycerin jelly as a mounting medium. A total of eight species of Tripsacum, three collections of teosinte and fourteen varieties of modern maize were chosen for purposes of comparison (Table I). A total of 34 large grass-pollen grains were ultimately

TABLE I

AXIS LENGTH, PORE DIAMETER AND PORE-AXIS RATIO IN TRIPSACUM, TEOSINTE, MODERN AND FOSSIL MAIZE

| Species | Number pollen grains measured | Pore-Axis Ratio | | | | | | | | | | | | | | | | | | | | | | | | | | | Averages | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 | 5.4 | 5.6 | 5.8 | 6.0 | 6.2 | 6.4 | 6.6 | 6.8 | 7.0 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 9.0 | Length Grain, $\mu$. | Diameter Pore, $\mu$. | Pore-Axis Ratio |
| Tripsacum | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *T. australe* No. 1 | 54 | | | 1 | 8 | 15 | 16 | 11 | 1 | 2 | | | | | | | | | | | | | | | | | | | 57.4 | 14.3 | 1:4.0 |
| " " No. 2 | 25 | | 1 | 2 | 3 | 5 | 7 | 4 | 2 | 1 | | | | | | | | | | | | | | | | | | | 57.2 | 14.3 | 1:4.0 |
| *T. dactyloides* | 50 | | | 4 | 2 | 8 | 16 | 10 | 6 | | 4 | | | | | | | | | | | | | | | | | | 50.2 | 12.2 | 1:4.1 |
| *T. lanceolatum* | 49 | | 3 | 4 | 7 | 7 | 13 | 4 | 11 | | | | | | | | | | | | | | | | | | | | 49.9 | 12.5 | 1:4.0 |
| *T. latifolium* | 50 | | | 5 | 9 | 15 | 8 | 8 | 4 | 1 | | | | | | | | | | | | | | | | | | | 41.9 | 10.6 | 1:1.4 |
| *T. laxum* | 50 | | | 2 | 16 | 16 | 13 | 3 | | | | | | | | | | | | | | | | | | | | | 57.2 | 14.7 | 1:3.9 |
| *T. maizar* | 25 | 1 | 1 | 1 | 2 | 2 | 6 | 4 | 7 | 1 | | | | | | | | | | | | | | | | | | | 41.7 | 10.3 | 1:4.0 |
| *T. pilosum* | 42 | 1 | 2 | 3 | 6 | 13 | 10 | 5 | 2 | | | | | | | | | | | | | | | | | | | | 57.1 | 14.7 | 1:3.9 |
| Teosinte | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mexico, "Chalco" | 50 | | | | | | 1 | | 2 | 5 | 5 | 14 | 9 | 6 | 6 | 1 | | 1 | | | | | | | | | | | 81.8 | 15.9 | 1:5.1 |
| Guatemala No. 1 | 31 | | | | | | | | | 2 | 3 | 5 | 5 | 5 | 6 | 3 | 2 | | | | | | | | | | | | 86.4 | 16.0 | 1:5.4 |
| Guatemala No. 2 | 32 | | | | | | | | | | 4 | 4 | 6 | | 4 | | 3 | 2 | | | | | | | | | | | 79.3 | 14.7 | 1:5.4 |
| Maize | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| United States | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Thompson Flint | 50 | | | 1 | | | 5 | 7 | 15 | 6 | 6 | 3 | 3 | 2 | 2 | | | | | | | | | | | | | | 120.7 | 19.4 | 1:6.2 |
| Thayer Flint | 50 | | | | | | 2 | 3 | 8 | 5 | 8 | 8 | 6 | 5 | 1 | 1 | | | 1 | 2 | | | | | | | | | 122.8 | 18.8 | 1:6.5 |
| Knobless | 30 | | | | | | | 2 | 2 | 2 | 8 | 12 | 2 | | 2 | | | | | | | | | | | | | | 118.8 | 18.2 | 1:6.5 |
| Mexico | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chapalote | 50 | | | | 6 | 8 | 4 | 6 | 8 | 4 | 8 | 4 | 2 | | | | | | | | | | | | | | | | 94.9 | 15.4 | 1:6.2 |
| Jala | 50 | 1 | 1 | 1 | 5 | 8 | 10 | 7 | 6 | 4 | 5 | 1 | | | | | | | | | | | | | | | | | 96.6 | 15.6 | 1:6.2 |
| Nal-Tel | 47 | | | | 2 | 4 | 10 | 6 | 5 | 2 | 2 | 4 | 4 | 1 | 2 | 2 | 1 | 2 | | | | | | | | | | | 87.2 | 13.2 | 1:6.6 |
| Tabloncillo | 50 | 1 | 2 | 3 | 6 | 6 | 9 | 8 | 3 | 6 | | 2 | 2 | 2 | | | | | | | | | | | | | | | 98.6 | 16.0 | 1:6.2 |
| Tuxpeño | 50 | | 2 | 2 | 6 | 6 | 8 | 4 | 16 | | | | 4 | | | | 2 | | | | | | | | | | | | 99.0 | 15.8 | 1:6.3 |
| Vandeño | 50 | | 4 | 8 | 7 | 10 | 5 | 5 | 3 | 4 | | | 1 | | 1 | 1 | 1 | | | | | | | | | | | | 97.1 | 16.1 | 1:6.0 |
| Zapalote Chico | 50 | 2 | 2 | 6 | 2 | 6 | 18 | 8 | 6 | | | | | | | | | | | | | | | | | | | | 94.7 | 15.9 | 1:6.0 |
| Costa Rica No. 1045 | 50 | | | | 2 | | 18 | 4 | 4 | 6 | 2 | 4 | 8 | 2 | | | | | | | | | | | | | | | 104.6 | 16.0 | 1:6.5 |
| Peru | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. 300 | 50 | | | | 5 | 6 | 9 | 10 | 10 | 7 | 3 | | | | | | | | | | | | | | | | | | 95.7 | 15.8 | 1:6.1 |
| No. 420 | 50 | 2 | | 2 | 12 | 4 | 14 | 8 | 4 | | 2 | 2 | | | | | | | | | | | | | | | | | 99.0 | 16.4 | 1:6.1 |
| No. 427, "Cuzco" | 50 | | 1 | | 5 | 7 | 16 | 8 | 8 | 2 | 1 | 2 | | | | | | | | | | | | | | | | | 92.1 | 15.3 | 1:6.0 |
| Archaeological | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bat Cave, Late | 50 | 1 | 1 | 1 | 5 | 3 | 7 | 7 | 10 | 6 | | 2 | 3 | 1 | 2 | 1 | | | | | | | | | | | | | 88.7 | 14.1 | 1:6.3 |
| Bat Cave, Early | 10 | 2 | | | 1 | 2 | 1 | 1 | 1 | | 1 | 1 | | | | | | | | | | | | | | | | | 93.1 | 15.2 | 1:6.1 |
| Fossil, Mexico City | 14 | 1 | | 2 | 1 | 3 | 1 | 2 | | | 1 | 1 | 2 | | | | | | | | | | | | | | | | 95.6 | 15.5 | 1:6.2 |

secured from the lower levels of the Belles Artes core. These lower-depth grains received the most careful study, although an additional 44 large grass-pollen grains from the upper levels of the Belles Artes and Madero cores were also examined by the same procedures.

In the course of making measurements, it early became evident that a wide range in the size of the pollen grains characterizes each of the three genera, a condition possibly indicative of their unusual genetic variability. In Tripsacum, a wide-ranging and common genus of subtropical and temperate North America, the *average* for the long axes of the pollen grain varied between 41.7$\mu$ in *T. maizar* and 57.4$\mu$ in *T. australe*, with an extreme range in the genus of 33.6$\mu$ to 64.0$\mu$. In teosinte, of the three forms examined, the *average* length varied between 79.3$\mu$ and 86.4$\mu$, with extremes of 74.0$\mu$ and 102.0$\mu$; whereas in maize the *average* range fluctuated between 87.2$\mu$ (Mexico "Nal Tel") and 122.8$\mu$ with extremes of 72$\mu$ and 141.7$\mu$. It is evident that the smaller pollen of some of the varieties of cultivated maize measured in this study fall well within the range of teosinte and close to that of the largest Tripsacum grains. It is apparent, therefore, that size alone cannot be utilized for the critical identification of presumed fossil maize pollen, and that of its relatives, unless a sufficient number of intact grains are available to be measured and plotted on size-frequency curves to show the statistical probability of one of three possibilities. Owing to the small number of individual intact grains from the Mexican borings, however, this procedure was not possible.

Because of the paucity of structural features and the undistinctive sculpture pattern of the pollen exines of the three genera under consideration, it became necessary to attempt some other means of distinguishing the three pollen-types. Consideration of the problem led to one

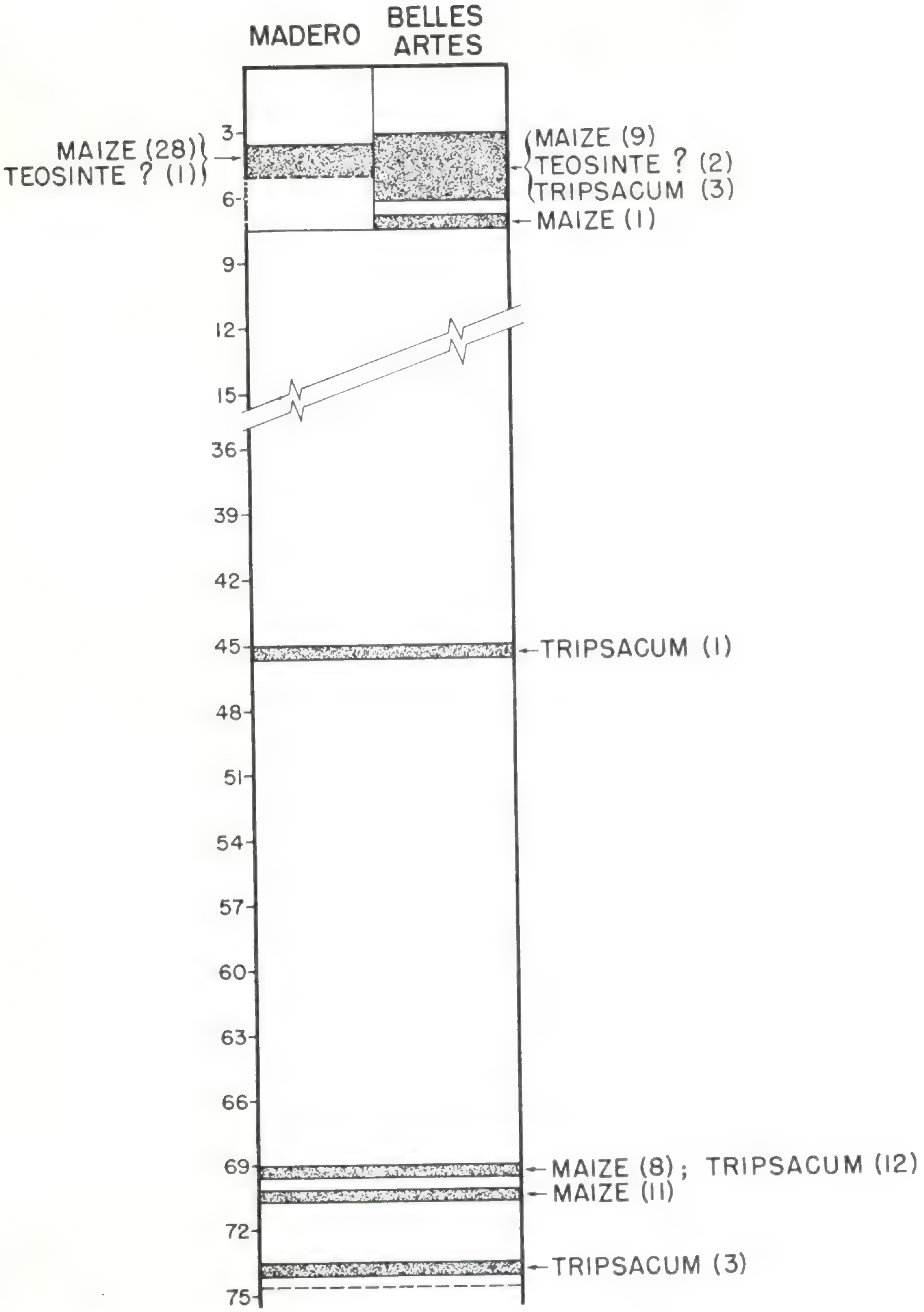
other possibility, viz: a comparison of the ratio in size which exists between the pore (including the annulus) of the pollen grain and that of its long axis (Text Fig. 2).

In order to establish these ratios and to determine their constancy, if any, approximately 50 additional grains were measured from each preparation with respect to these dimensions. In the case of the fossil grains all those exhibiting intact pores were measured. The measurements were averaged and the ratios computed from the averaged value for each species. The results showed encouraging consistency, the ratio of pore to long axis being an unexpectedly conservative value, and, more important to the problem at hand, significantly different among the three species in question. The numerical values computed are shown in Table II.

Although the data are limited to approximately 1000 pollen grains, the differences are so consistent, both with respect to individual grains and averages as well, that the pore-long-axis ratio appears to be a valid means of always distinguishing maize pollen from that of Tripsacum, and in some instances from that of teosinte. It may be noted also in connection with this analysis, that teosinte, a postulated hybrid between maize and Tripsacum (Mangelsdorf and Reeves, 1939), shows an intermediate value both in overall size, and perhaps more significantly, in its pore-ratio. The intermediate value is well in harmony with the postulated hybrid origin of teosinte.

Fossil pollen grains resembling maize, teosinte and Tripsacum in size and in their pore-axis ratios occur in the upper levels of both the Madero and Belles Artes

TEXT FIG. 1 (opposite page). Diagram showing the distribution and frequency of maize, teosinte and Tripsacum in samples studied from the Madero and the Belles Artes cores. Note that the Belles Artes core was sampled throughout, the Madero core only to a depth of 5 meters. Numbers in parentheses indicate the number of individual grains. Depth is indicated in meters.


MADERO
BELLES ARTES
3
6
9
12
15
36
39
42
45
48
51
54
57
60
63
66
69
72
75
MAIZE (28)
TEOSINTE ? (1)
MAIZE (9)
TEOSINTE ? (2)
TRIPSACUM (3)
MAIZE (1)
TRIPSACUM (1)
MAIZE (8); TRIPSACUM (12)
MAIZE (11)
TRIPSACUM (3)

## EXPLANATION OF THE ILLUSTRATION

PLATE XXXVIII. Photomicrographs of fossil, archeological and modern maize pollen grains.

1, Belles Artes core sample number 163, slide number 5. Note pore at extreme upper right, and characteristic folds of the exine. ×435

2, Belles Artes core sample number 148, slide number 1. Pore is clearly visible in upper central portion of grain. ×435

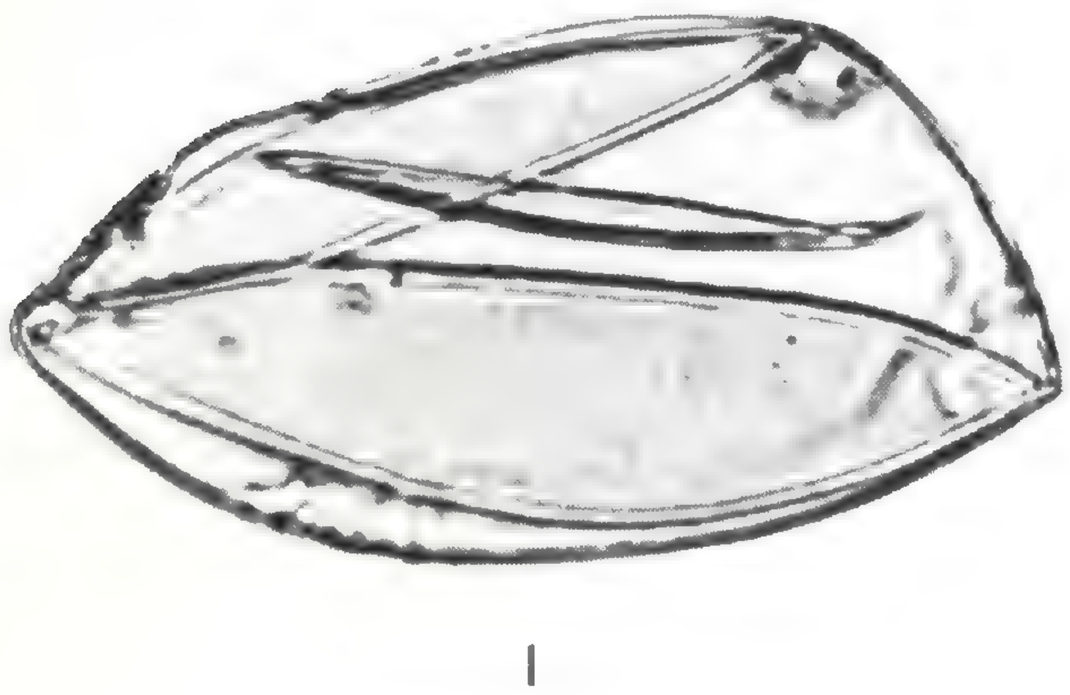
3, Belles Artes core sample number 163, slide number 1a. Pore is visible at lower right. The grain is nearly round, but deeply folded. ×435

4, Bat Cave, New Mexico. Dated by radio-carbon age determination of associated charcoal at 5600± years. Note large size of grain and conspicuous pore. ×435

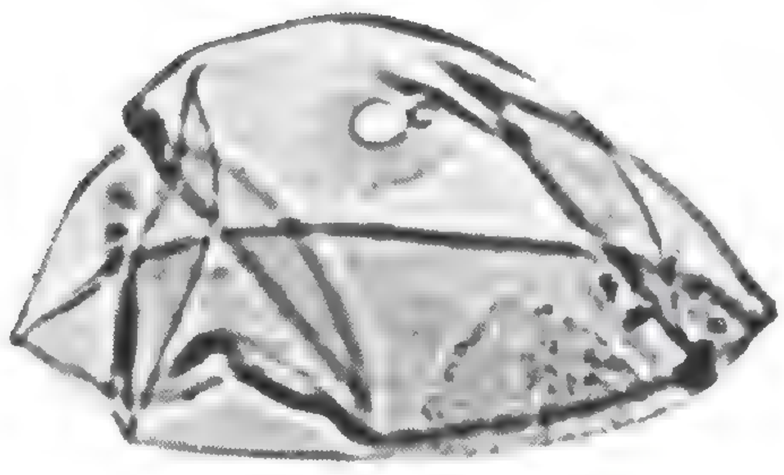
5, Bat Cave, New Mexico. Same source and age as grain shown in fig. 4. ×435

6, Thayer Flint, modern maize, for comparison with fossil maize pollen. Note conspicuous pore in central upper portion of figure. ×435

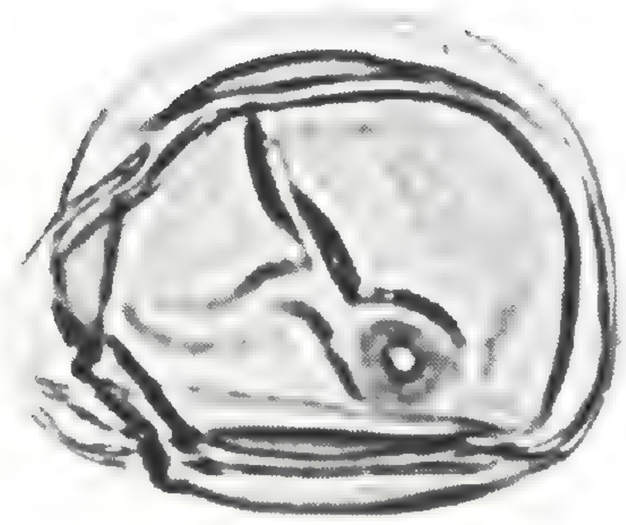
# Plate XXXVIII



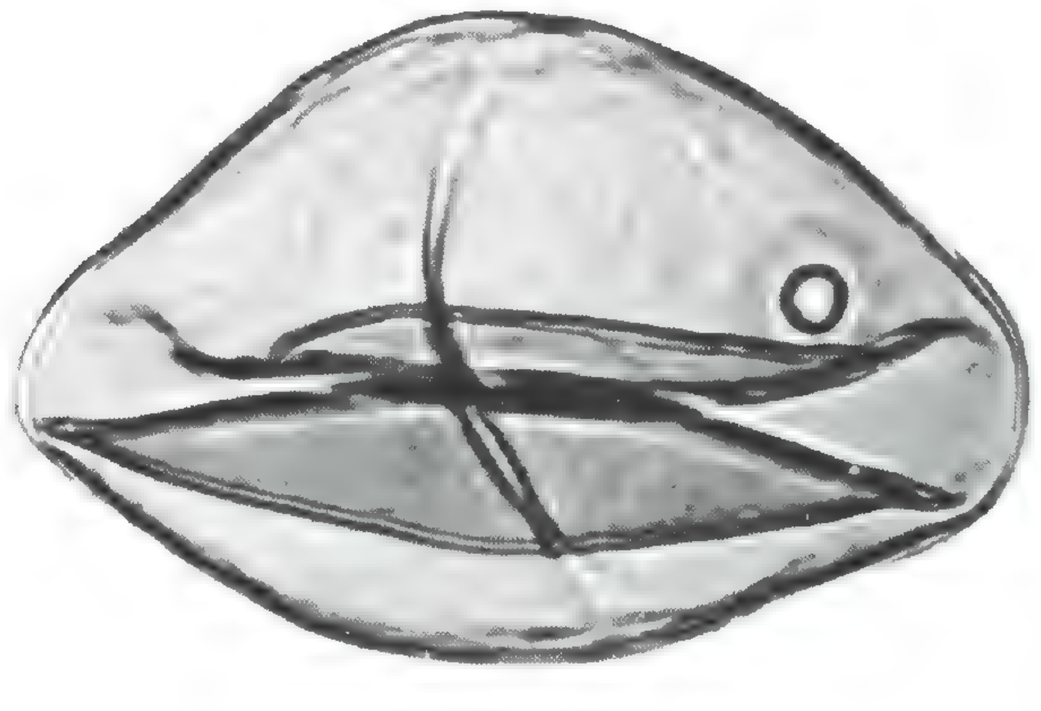
1



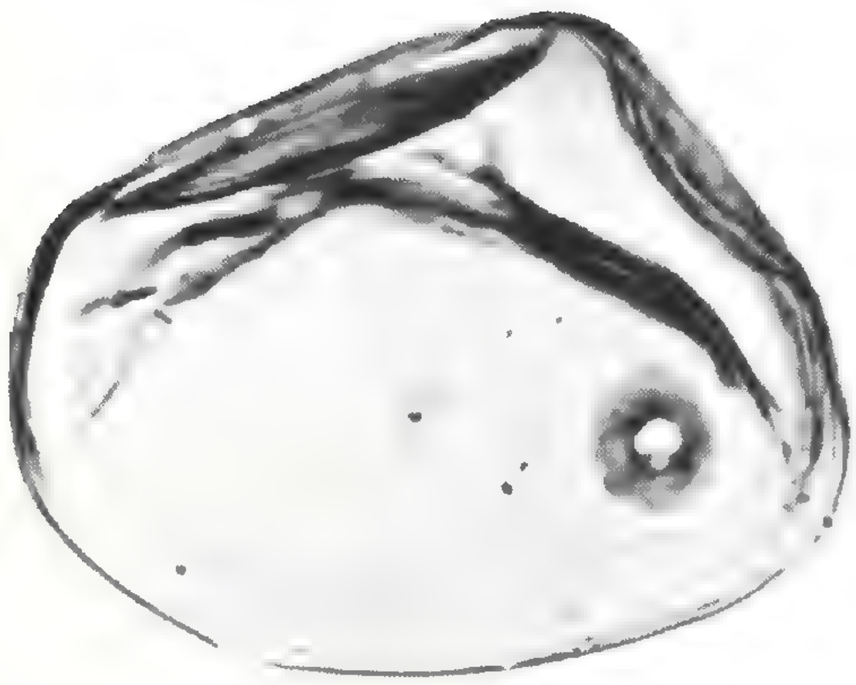
2



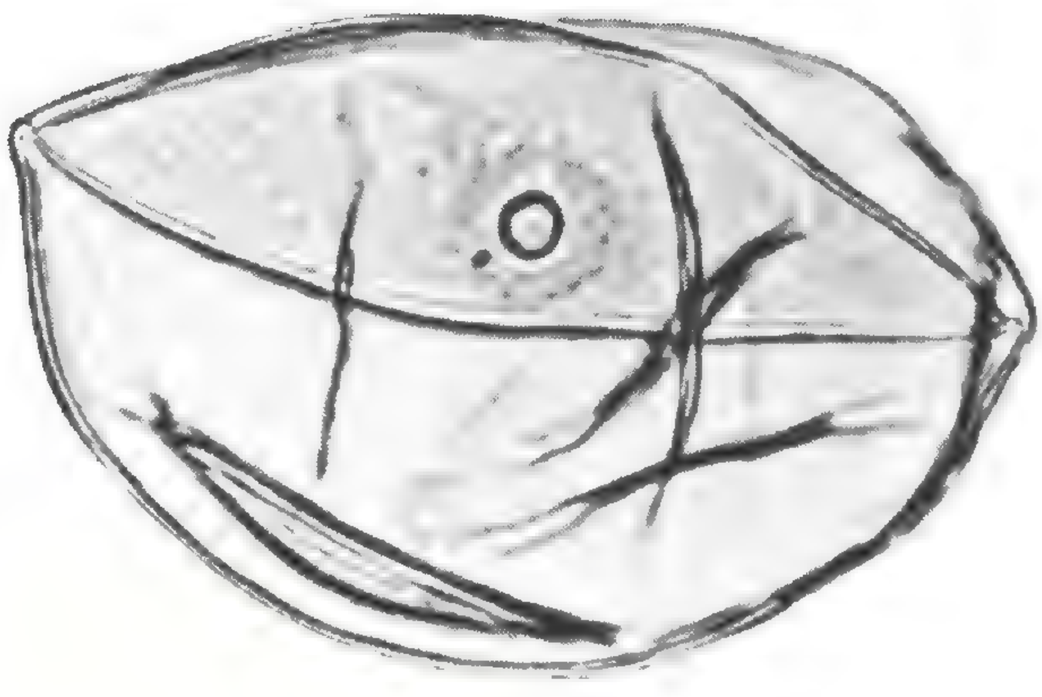
3



4

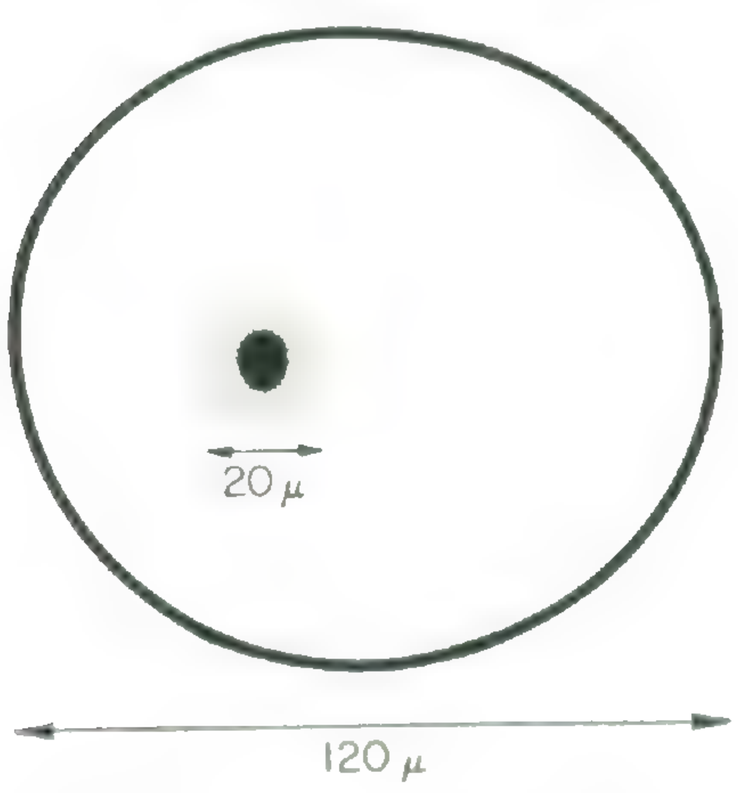


5



6

cores. The larger grains, 38 in number, from these upper levels (above 6.0 meters) presumably represent the pollen of cultivated maize, and indeed many grains are well within the upper range of several modern varieties. Three grains of intermediate size and pore-ratio in the upper levels (3.3 and 3.6 meters) possibly represent the pollen of teosinte, a common weed in and around the maize fields in the Valley of Mexico today. Three grains conforming to Tripsacum were secured from the upper levels of the Belles Artes core and, interestingly enough, one Tripsacum grain from the 45 meter level of the same core. No pollen grains clearly assignable to teosinte were found below the 3.6 and 3.3 meter levels respectively in either core (Text Fig. 1). This may indicate that teosinte did not become established in the Valley of Mexico until some time after maize-cultivation had begun. However, the total number of grains involved is small and the differences in levels may represent the product of sampling.




TEXT FIG. 2. Diagram showing the pore-axis relationship. Note that the outer borders of the annulus (shaded portion surrounding the pore) are included in the pore measurement. (The ratio is determined by dividing the numerical value, in microns, of the long axis by the numerical value, in microns, of the pore.)

By far the most significant discovery is that of large pollen grains, closely resembling modern maize, in the 69 and 70 meter levels in the Belles Artes core. A total of 19 large grains were secured, 14 of which were sufficiently preserved to permit a pore-axis measurement. Of the 19, 8 are well outside the extreme size-range for teosinte, as determined in this study, and of the remaining 11, four are outside the extreme range of the pore-axis

TABLE II

DATA ON INDIVIDUAL FOSSIL POLLEN GRAINS OF TRIPSACEAE FROM MEXICO CITY CORES

| Core | Core Sample Number | Slide Number | Depth Meters | Description | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Size μ | | Pore-Axis | |
| | | | | Condition | Axis | Pore | Ratio | Identification |
| Belles Artes | 148 | 1 | 74.2–74.5 | elongated | 66.0 | 13.5 | 4.8 | Tripsacum |
| " " | " | 2 | " " | good | 55.5 | 12.0 | 4.6 | Tripsacum |
| " " | " | 7 | " " | n.p.v.* | 45.0 | — | — | Tripsacum |
| " " | 163 | 1 | 70.3–70.5 | entire | 90.0 | 16.5 | 5.4 | Maize |
| " " | " | 1a | " " | good | 75.0 | 13.5 | 5.5 | Maize |
| " " | " | 2 | " " | good | 93.0 | 15.0 | 6.2 | Maize |
| " " | " | 3 | " " | n.p.v. | 132.0 | — | — | Maize |
| " " | " | 4 | " " | fragment | 79.5 | 13.5 | 5.8 | Maize |
| " " | " | 5 | " " | entire | 127.0 | 17.2 | 7.3 | Maize |
| " " | " | 6 | " " | fair | 124.0 | 21.0 | 5.9 | Maize |
| " " | " | 7 | " " | fair | 124.0 | 18.0 | 6.9 | Maize |
| " " | " | 8 | " " | good | 87.0 | 15.0 | 5.8 | Maize |
| " " | " | 9 | " " | n.p.v. | 129.0 | — | — | Maize |
| " " | " | 10 | " " | poor | 135.0 | 18.0 | 7.5 | Maize |
| " " | 165 | 2 | 69.7–69.9 | good | 63.0 | 16.5 | 3.8 | Tripsacum |
| " " | " | 3 | " " | pore eroded | 63.0 | — | — | Tripsacum |
| " " | " | 11a | " " | eroded | 64.5 | — | — | Tripsacum |
| " " | " | 11b | " " | elongated | 69.0 | 13.5 | 5.1 | Tripsacum |
| " " | " | 16 | " " | elongated | 60.0 | 15.0 | 4.0 | Tripsacum |
| " " | " | 19 | " " | elongated | 67.5 | 15.0 | 4.5 | Tripsacum |
| " " | " | 23 | " " | elongated | 64.5 | 15.0 | 4.3 | Tripsacum |
| " " | " | 26 | " " | poor | 55.5 | 15.0 | 3.7 | Tripsacum |
| " " | " | 39 | " " | eroded | 60.0 | 12.0 | 5.0 | Tripsacum |
| " " | " | 41 | " " | fair | 75.5 | 13.5 | 5.5 | Maize |
| " " | " | 41a | " " | eroded | 54.0 | — | — | Tripsacum |
| " " | " | 43 | " " | fair | 79.5 | 13.5 | 5.8 | Maize |
| " " | 166 | 2 | 69.3–69.5 | good | 92.5 | 16.5 | 5.6 | Maize |
| " " | " | 3b | " " | good | 73.5 | 12.0 | 6.1 | Maize |
| " " | " | 12 | " " | crushed | 70.5 | 10.5 | 6.7 | Maize |
| " " | " | 18a | " " | good | 75.0 | 15.0 | 5.0 | Maize |
| " " | " | 18b | " " | fair | 55.5 | 12.0 | 4.6 | Tripsacum |
| " " | " | 21 | " " | fair | 84.0 | 12.0 | 7.0 | Maize |
| " " | " | 26 | " " | pore poor, fragment | 54.0 | — | — | Tripsacum |
| " " | " | 31 | " " | good | 105.0 | 16.5 | 6.3 | Maize |
| " " | " | 47 | " " | good | 109.5 | 15.0 | 7.3 | Maize |
| " " | " | 63 | " " | pore not clear | 66.0 | 15.0 | 4.4 | Tripsacum |
| " " | 189 | 1 | 45.1–45.3 | pore not clear, grain elongated | 72.0 | — | — | Tripsacum |
| " " | 232 | 1 | 7.4–7.6 | very poor, fragment | 135.0 | — | — | Maize |
| " " | 234 | 3 | 5.9–6.1 | good | 108.5 | 15.0 | 6.0 | Maize |
| " " | 235 | 5 | 5.1–5.2 | good | 52.5 | 12.0 | 4.3 | Tripsacum |
| " " | " | 8 | " " | good | 112.5 | 19.5 | 5.7 | Maize |
| " " | " | 9 | " " | fair | 82.5 | 15.0 | 5.5 | Maize |
| " " | " | 10 | " " | fair | 97.5 | 16.5 | 5.9 | Maize |
| " " | 236 | 4 | 4.4–4.6 | fair | 76.5 | 12.0 | 6.3 | Maize |
| " " | " | 5 | " " | pore not clear | 79.5 | — | — | Maize |
| " " | " | 7 | " " | pore not clear | 90.0 | — | — | Maize ? |
| " " | " | 8 | " " | good | 45.0 | 9.0 | 5.0 | Tripsacum |
| " " | " | 10 | " " | n.p.v. | 82.5 | — | — | Maize |
| " " | 237 | 11 | 3.6–3.8 | pore not clear | 55.5 | — | — | Tripsacum |
| " " | " | 12 | " " | pore not clear | 70.5 | 15.0 | 4.7 | Teosinte ? |
| " " | " | 13 | " " | pore not clear | 69.0 | 12.0 | 5.7 | Maize |
| " " | " | 14 | " " | pore not clear | 64.5 | 15.0 | 4.3 | Teosinte ? |
| Madero | 135 | 1 | 6.0 | elongated good | 130.0 | 15.0 | 8.8 | Maize |
| " | 130 | 1 | 5.1 | n.p.v. | 126.0 | — | — | Maize |
| " | 128 | 1 | 4.9 | good | 132.0 | 21.0 | 6.2 | Maize |
| " | " | 2 | " | n.p.v. | 96.0 | — | — | Maize |
| " | " | 4 | " | n.p.v. | 87.0 | — | — | Maize ? |
| " | " | 6 | " | n.p.v. | 99.0 | — | — | Maize |
| " | " | 7 | " | elongated | 144.0 | — | — | Maize |
| " | 126 | 1 | 4.5 | n.p.v. | 103.5 | — | — | Maize |
| " | " | 3 | " | good | 120.0 | 19.5 | 6.1 | Maize |
| " | " | 4 | " | n.p.v. | 99.0 | — | — | Maize |
| " | " | 6 | " | good | 105.0 | 18.0 | 5.8 | Maize |
| " | 124 | 1 | 4.1 | pore not clear | 140.0 | — | — | Maize |
| " | " | 2 | " | pore not clear | 105.0 | — | — | Maize |
| " | " | 3 | " | n.p.v. | 105.0 | — | — | Maize |
| " | " | 4 | " | pore not clear | 99.0 | — | — | Maize |
| " | " | 5 | " | fair | 135.0 | 16.5 | 8.1 | Maize |
| " | 120 | 1 | 3.3 | n.p.v. | 127.5 | — | — | Maize |
| " | " | 2 | " | good | 99.0 | 16.5 | 6.0 | Maize |
| " | " | 3 | " | n.p.v. | 112.5 | — | — | Maize |
| " | " | 4 | " | pore not clear | 66.0 | 12.0 | 5.5 | Teosinte ? |
| " | " | 5 | " | good | 124.0 | 18.0 | 6.9 | Maize |
| " | " | 6 | " | n.p.v. | 124.5 | — | — | Maize |
| " | " | 7 | " | n.p.v. | 105.0 | — | — | Maize |
| " | " | 8 | " | good | 124.0 | 18.0 | 6.9 | Maize |
| " | 119 | 1 | 3.1 | fair | 90.0 | 15.0 | 6.0 | Maize |
| " | " | 2 | " | n.p.v. | 100.3 | — | — | Maize |

* n.p.v. indicates no pore visible for measurement.

ratio for teosinte, although within the upper level of the long axis dimension of teosinte. The existence of these large fossil grass-grains at these great depths calls for an explanation and the following possibilities must be considered.

1. The fossil grains are those of a wild grass, not related to maize or its relatives. This possibility seems quite remote, since, except for the cultivated cereals of the Old World, no grass pollen approaching this size is known.

2. The grains represent contamination occurring in the laboratory. This possibility has been eliminated from consideration by re-examination and re-isolation of grains from additional samples of the core sediments. It may also be ruled out on the grounds of the physical, chemical and optical properties of the fossil grains when compared to modern maize pollen.

3. The grains represent contamination which occurred in Mexico during the core drilling (a) either as atmospheric contaminants or (b) as stratigraphic contaminants during the drilling operations. Possibility 3a can be excluded on the same grounds as possibility 2. Possibility 3b can logically be excluded on the ground that if the large fossil grains were carried down from the upper 6 meter levels, they should be found at intermediate depths. However, the large grains have not been found between the 6 meter level and the 69 meter level, with the sole exception of the one Tripsacum grain referred to previously.

4. The grains are those of either Tripsacum or teosinte

which have increased in size and corresponding pore-axis ratio as a result of preservation under rather unusual sedimentary conditions. There is obviously no way to prove that this is not true, but if it were the case, it would be totally inconsistent with previous extensive experience by numerous investigators in dealing with Pleistocene and Tertiary microfossils.

5. The pollen grains are those of ancient maize. This appears to be the most reasonable interpretation and certainly from the evidence now at hand the only plausible one. The large fossil grains resemble maize pollen not only in their general appearance but in their size, and when it can be determined, in their pore-axis ratio. They differ somewhat from pollen grains of modern maize in possessing a slightly thicker exine and, more significantly, a smoother contour in folding. Although these differences may be due in part to conditions of preservation and post depositional change, it is of interest to note that the prehistoric pollen from Bat Cave, New Mexico shares these properties to some extent; but they are less evident in modern maize (Plate XXXVIII).

Only one of the well preserved grains from the lower levels does not fall within the range of Tripsacum or maize. This grain measures 70.5$\mu$ in length, with a pore-axis ratio of 4.7, which is outside the range of maize as determined by our measurements. In pore-ratio it is just within the extreme for Tripsacum and the lower range for teosinte. Whether this one specimen represents an unusually large grain of Tripsacum, other grains of which have been found at this level, or a slightly atypical grain of teosinte, cannot be determined. There remains a re-

mote possibility, therefore, that both maize and teosinte were growing at the time the deeper sediments were deposited.

Although definite palynological and geologic conclusions have not yet been drawn as to the antiquity of the lowest portions of the Mexico City cores, the available evidence indicates that the sediments extend well back in Wisconsin time, most probably to the early stages of the Iowan advance of the Wisconsin Ice sheet.[1] If this is the case, the fossil maize pollen with which we are concerned almost certainly antedates the practice of agriculture in North America, and probably precedes the advent of man on this continent.

[1] Personal communication from Professor Paul B. Sears.

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# A NEW NARCOTIC SNUFF FROM THE NORTHWEST AMAZON

BY
RICHARD EVANS SCHULTES

## I.

AN interesting new drug has been added to our growing list of native narcotic and stimulant plants of South America. Recent investigations have uncovered the use amongst certain Indians of eastern Colombia and northwestern Brazil of several species of the myristicaceous genus *Virola* in the preparation of a violently toxic snuff which is employed by the medicine-men in witchcraft, divination and the diagnosis of illness.

## II.

During the course of exploration of the Río Apaporis in Amazonian Colombia in 1951 and 1952, I had as helpers several Indians of the Puinave tribe from the little known Río Inirida. The Inirida is the highest Colombian affluent of the Orinoco and, although botanically completely unknown, it represents apparently an area where the Amazon (Río Negro-Vaupés) and Orinoco floras blend. Consequently, my Puinave helpers, from whom I first learned of this myristicaceous snuff, were familiar with many of the plants encountered in the Apaporis basin.

During 1951, the uninhabited Río Apaporis was opened up for tapping wild rubber, and natives from

various tribes of the Colombian Comisaría del Vaupés and the Rio Vaupés of Brazil were transported into the area by air. Thus, I had an unparalled opportunity of investigating the preparation of the narcotic by natives of tribes isolated from one another by long distances. To the present, the investigation has disclosed the use of the snuff in Colombia amongst the Puinaves of the Río Inirida, the Kuripakos of the Río Guainía, the Kubeos of the Río Vaupés and its Colombian affluents, the Tukanos of the Ríos Vaupés and Papurí, the Barasanas and Makunas of the Rio Piraparaná and the Taiwanos of the Río Kananarí. In Brazil, its use is known amongst the Tukanos of the Rio Vaupés, and there is some indirect evidence that the several tribes of the Rio Issana likewise employ it.

The narcotic snuff prepared from species of *Virola* is called *yá-kee* in Puinave and *yá-to* in Kuripako; the Tukanos call it *pa-ree-ká*, which is a loan word from the Nheêngatú or Lingoa Geral *paricá*, the term by which the snuff is known in the Rio Negro-Vaupés area of Brazil.

The species of *Virola* employed in preparing the narcotic snuff have been verified as the following:[1]

1. **Virola calophylla** *Warburg* Nova Acta Acad. Leop.-Carol. 68 (1897) 231.

*Myristica calophylla* Spruce Journ. Linn. Soc. 5 (1860) 4, *nomen nudum*.

*Virola incolor* Warburg *loc. cit.* 232.

*Otoba incolor* Karsten ex Warburg *loc. cit.* 232, *in synon.*

This species is known from Amazonian Brazil and adjacent parts of Colombia, Peru and Venezuela. Prior to the collection of the material cited below, the species was known in Colombia only from Villavicencio. Subsequent

[1] I acknowledge gratefully the verification of my identifications by Dr. A. C. Smith of the Smithsonian Institution.

collections and observations have shown it to be rather common in Amazonian Colombia. The type (*Spruce 3207*) was collected a century ago by Spruce along the Casiquiare in Venezuela.

The following collections of *Virola calophylla* are those upon which the identification of one source of the narcotic snuff was made.

Colombia: Comisaría del Amazonas, Río Apaporis, Soratama, entre el Río Pacoa y el Río Kananarí. Alt. about 250 m. "Small tree about 35 feet tall; diameter 8–9 inches. Bark exudes inside a reddish resin when ripped off tree. Externally reddish brown, pebbled. Puinave = *yá-kee*. Source of narcotic snuff. In flood-forest." June 26, 1951, *Richard Evans Schultes & Isidoro Cabrera 12855*.—Same locality. "Large columnar tree. Source of *yá-kee* snuff. Flood-forest." August 16, 1951, *Schultes & Cabrera 13587*.

2. **Virola calophylloidea** *Markgraf* Repert. Sp. Nov. 19 (1923) 24.

*Virola lepidota* A. C. Smith in Brittonia 2 (1936) 152.

This species, the type of which was collected in Manáos by Ule (*Ule 8846*) half a century ago, is rare in Amazonian Brazil in the Rio Negro and Rio Madeira valleys. Hitherto, it has not been known from Colombia, where it appears to be much less common than *Virola calophylla* in the Amazonian regions.

The following collection of *Virola calophylloidea* is that upon which the identification of the second source of the narcotic snuff was made.

Colombia: Comisaría del Amazonas, Río Apaporis, Soratama, entre el Río Pacoa y el Río Kananarí. Altitude about 250 m. "Small tree along flood-bank. Flowers brownish. Puinave name = *yá-kee*. Source of narcotic snuff." July 3, 1951, *Richard Evans Schultes & Isidoro Cabrera 12872*.

3. **Virola** spp.

The possibility that other species of *Virola* are used in this way must not be overlooked. The Tawaino Indians of the Río Kananarí in Amazonian Colombia pointed out

## EXPLANATION OF THE ILLUSTRATION

PLATE XXXIX. VIROLA CALOPHYLLA *Warburg*. 1, habit, approximately one half natural size. 2, flowers, approximately ten times natural size.

*Drawn by* ELMER W. SMITH

PLATE XXXIX

# *VIROLA calophylla Warburg*

## EXPLANATION OF THE ILLUSTRATION

PLATE XL. VIROLA CALOPHYLLOIDEA *Markgraf.* 1, habit, approximately one half natural size. 2, flowers, approximately ten times natural size.

*Drawn by* ELMER W. SMITH

PLATE XL

a tree of this genus as representing their source of *paricá*, but there seemed to be some disagreement amongst the several informers. A sterile collection from the tree has been determined with reservation by Dr. A. C. Smith as *Virola elongata* (Benth.) Warburg.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, at base of Cerro Isibukurí, August 4, 1951, *Richard Evans Schultes & Isidoro Cabrera 13278*.

## III.

What seems almost certainly to have been this unusual narcotic *Virola*-snuff was apparently first noticed and reported by the famous German ethnologist, Theodor Koch-Grünberg, who explored the northwest Amazon and adjacent areas in the upper Orinoco basin in the early part of this century. The botanical source of the snuff, however, was not ascertained. Writing of the Yekwaná (Yecuaná) tribe of the Río Ventuari in Venezuela, Koch-Grünberg (Koch-Grünberg: "Von Roraima zum Orinoco, Ergebnisse einer Reise in Nord-Brasilien und Venezuela in den Jahren 1911–13" 3 (1923) 386) reported the following concerning this narcotic:

> Of an especial magical importance are the cures during which the witch-doctor inhales *hakúduf$^{h}$a*. This is a magical snuff used exclusively by the witch-doctors and prepared from the bark of a certain tree which, pounded up, is boiled in a small earthenware pot until all the water has evaporated and a sediment remains at the bottom of the pot. This sediment is toasted in the pot over a slight fire and is then finely powdered with the blade of a knife. Then the sorcerer blows a little of the powder through a reed (*kuratá*) into the air. Next he snuffs, whilst, with the same reed, he absorbs the powder into each nostril successively. The *hakúduf$^{h}$a* obviously has a strongly stimulating effect, for immediately the witch-doctor begins singing and yelling wildly, all the while pitching the upper part of his body backwards and forwards.

Dr. Adolpho Ducke, profound student of the Amazon flora for more than half a century, has attributed the *paricá* of the upper Rio Negro basin to the leaves of a

species of *Virola*. In a footnote to a discussion of *Piptadenia peregrina* L. he wrote (Ducke, A.: "As leguminosas da Amazônia brasileira" (1939) 41):

> Martius and other writers attribute to this species the source of the narcotic *paricá* employed by certain Amazonian Indians (the powder of the crushed seeds is inhaled through the nostrils). Notwithstanding, according to information which I obtained from the natives themselves in two localities in the upper Rio Negro, the *paricá*-powder comes from leaves of species of *Virola* of the *Myristicaceae*.

So far as I have been able to ascertain, this is the first and only reference in the literature to the use of *Virola* in the preparation of a narcotic snuff. I have been unable to substantiate the statement that the leaves are ever used; all of the many reports which I have gathered are in agreement and indicate that the bark is the portion of the plant employed in the preparation of the snuff. Ducke fails to make mention of the identification of *paricá* as *Virola* in the second edition of his "As leguminosas da Amazônia brasileira" (Bol. Téen. Inst. Agron. Norte 18 (1949) ).

## IV.

It would seem that *Virola* has not hitherto been reported as possessing strong narcotic properties. Nevertheless, extremely toxic and narcotic principles have been found in other members of the *Myristicaceae*. Perhaps the best known case is *Myristica fragrans* Houtt., which "unites to the medicinal properties of the ordinary aromatics considerable narcotic properties"; fatal and near-fatal consequences have attended its careless use in India (Wood, H. C., J. P. Remington and S. P. Sadtler: "The Dispensatory of the United States of America" ed. 18 (1899) 889). This thoroughly studied plant is the source of two spices of commerce: nutmeg and mace—the former derived from the dried, ripe seed without its seed coat and arillode, the latter from the dried arillode. Both

spices are employed medicinally as stimulants and carminatives, but in excessive doses they can produce mydriasis and stupor (Youngken, H. W.: "Textbook of pharmacognosy" ed. 5 (1943) 305 ff), and mace has been known to cause "alarming sensorial disturbances" (Watson, G. C. in Prov. Med. Surg. Journ. (Jan. 26, 1848) ). The toxic effects of *Myristica fragrans* are due apparently to a volatile oil, myristicine, which can act as a narcotic and which can cause a fatty degeneration of the liver (Finnemore, H.: "The essential oils" (1926) 274; Guenther, E.: "The essential oils" 5 (1952) 78). According to Youngken (*loc. cit.*), nutmeg contains up to 40% of a fixed oil and up to 10% of a volatile oil (4% of which is the narcotic principle myristicine). The whole family *Myristicaceae* is characterized by the presence of cells which contain a semi-fluid or crystalline oil, the color of which varies from yellow to red or even to a brownish black (Kraemer, H.: "Scientific and applied pharmacognosy" (1915) 250). It would appear probable, then, that the violent narcotic properties of *yákee*-snuff may be due, in great part if not entirely, to myristicine. Pharmacological studies which are at present under way will, it is hoped, clarify this interesting problem.

In the Indian Archipelago and New Guinea, other species of *Myristica* yield nutmeg, but there seems to be no record of the purposeful use of this genus amongst native Asiatic peoples as the source of a narcotic.

## V.

The preparation of *yákee*-snuff[2] is relatively simple. I have observed the process several times with Puinave Indians and have also seen the powder prepared by Tu-

[2] Because of the confusion which has grown up around the widely used term *paricá*, which will be discussed fully below, I prefer to employ the short, easily-pronounced and specific Puinave Indian name for the *Virola*-snuff.

kano and Kuripako Indians. In all cases, the fabrication was essentially the same and corresponds closely to Koch-Grünberg's brief description of its manufacture amongst the Yekwanás. Descriptions of the preparation as given to me by several Kubeo, Barasana and Makuna Indians indicate that no appreciable difference marks the process as practised by these tribes. In all instances, the same species were pointed out as sources of the snuff. We are, therefore, justified, I believe, in assuming that, in the area of its distribution in the Comisaría del Vaupés of eastern Colombia, as well as in the upper Rio Negro of Brazil, the preparation of *yákee* is well standardized. In this respect, it resembles coca (*Erythroxylum Coca* Lam.), the fabrication of which is, for practical purposes, the same throughout the area; on the other hand, it is unlike the famed narcotic *caapi* or *yajé* (*Banisteriopsis* spp.), the preparation of which seems to vary with almost each tribe.

The Indians usually strip the bark from the trees during the early hours of the morning, before the sun has begun to penetrate the forest canopy to heat up the trunk. Large strips of the bark, which peel easily from the cambium, are torn from the trunk and tied into loose bundles. Almost immediately upon separation of the bark from the tree, a profuse exudation or "bleeding" of a thick reddish resin-like liquid, which soon becomes viscous, oozes forth from the inner surface of the bark in small drops. The active principle is contained in this exudation—called *oom* (latex), or, specifically referring to these species of *Virola*, *há-oom-tee-ĕt* or *yá-kee-oom*, in Puinave. According to the Indians, this exudation is greatly reduced in quantity and is weaker in its narcotic effects when the trunk of the *Virola* tree has received the warmth of the sun's rays.

The bundles of bark are brought in and placed in water

for about half an hour. They are then taken out, and the soft inner layer, on the surface of which the red exudation has congealed, is rasped off with a knife or machete. The shavings or raspings (*yá-kee-taa* in Puinave) are thrown into an earthen pot or enamel tray, and the rest of the bark is discarded. When enough shavings have been accumulated, a small amount of water is added, and the mass is thoroughly kneaded and squeezed. The water becomes muddy and assumes a brownish or tan hue. This turbid liquid is strained several times, usually through a piece of finely hammered bark-cloth (prepared from a species of *Olmedia*) into a small-mouthed earthenware pot. The residual shavings, when as much of the water has been expressed as possible, are thrown away. Enough water is added to the strained liquid to fill the pot, which is then set to simmer over a slow fire. From time to time, a sordid foam, which rises to the surface, must be scraped off with a piece of bark. The boiling is allowed to continue for three or four hours, more water being added if evaporation be too rapid, until nothing remains except a thick, dark brown syrup at the bottom of the pot. This syrup must not be dried rapidly over a fire; the pot is set in the sun, and the syrup is permitted to solidify slowly. When nothing but a dry, brown crust is left, the residue is scraped free from the pot and is ground into a fine powder with a water-smoothed stone as a pestle and the pot or an enamelware tray as a mortar. It is then ready to be mixed with ashes which have been made, the while, from the bark of a small wild cacao tree (*Theobroma subincanum* Mart.). Usually equal amounts by volume of ashes and *yákee*-powder are used. When they are thoroughly mixed, the product is put into a small bag made of finely hammered bark (*Olmedia* sp.) or cloth and is sifted through the bag by means of a gentle beating against the side of a small-mouthed

receptacle. The resulting dust is the final snuff. It is kept either in a small glass bottle, tightly corked, or else, more traditionally, in a type of jar made, as Koch-Grünberg described, from a large snail-shell to which a hollow bird-bone tube has been fixed with pitch. This tube is stopped with a plug of feathers glued together with pitch at the basal end to form a tight-fitting stopper.

The consumption of *yakee*-snuff is limited to medicine-men and is, therefore, small. Since it is said to lose its intoxicating properties rather rapidly, even when in a tight container, it is made in small amounts and frequently.

## VI.

It may be of interest to append a few observations which I was able to make personally after taking *yakee*-snuff. I took about one-third of a level teaspoonful of the drug in two inhalations using the characteristic V-shaped bird-bone apparatus by means of which the natives blow the powder into the nostrils. This represents about one-quarter the dose usually absorbed by a diagnosing medicine-man, who takes about one slightly heaped teaspoonful in two or three inhalations at close intervals (of approximately fifteen or twenty minutes).

The dose was snuffed at five o'clock one afternoon. Within fifteen minutes a drawing sensation over the eyes was felt, followed very shortly by a strong tingling in the fingers and toes. The drawing sensation in the forehead rapidly gave way to a strong and constant headache. Within one half hour, there was a numbness of the feet and hands and an almost complete disappearance of sensitivity of the finger-tips; walking was possible with difficulty, as in a case of beri-beri. Nausea was felt until about eight o'clock, accompanied by a general feeling of lassitude and uneasiness. Shortly after eight, I lay down in my hammock, overcome with a heavy drowsiness

which, however, seemed to be accompanied by a muscular excitation, except in the extremities of the hands and feet. At about nine-thirty, probably, I fell into a fitful sleep which continued, with frequent awakenings, until morning. The strong headache over the eyes lasted until noon. A profuse and uncomfortable sweating, especially of the armpits, and what might have been a slight fever lasted from about six o'clock all through the night. There was a strong dilation of the pupils during the first few hours of the experiment. No food was taken and no tobacco was smoked from the time the experiment began until one o'clock in the afternoon—that is, for twenty hours during the course of the experiment.

Since this experiment was performed under primitive conditions in the jungle, all observations had to be made by myself. In spite of its many and serious shortcomings, the experiment indicates the narcotic strength of the snuff.

The dose employed by the medicine-men is sufficient to put them into a deep but disturbed sleep, during which delirious mumblings or, sometimes, shouts are emitted; visual hallucinations or dreams are reported to accompany the narcotic sleep very often. These are "interpreted" by an assistant who awaits the prophetic or divinatory sounds. Some medicine-men, it is said, are affected more violently than others and uncontrollable twitching of the fingers and facial muscles and a popping of the eyes are not infrequent symptoms. There is one report of the death, about twenty years ago, of a Puinave medicine-man on the Inirida River, whilst he was under the influence of *yákee*. Some *payés* (witch-doctors) are said to take *yákee* as frequently as four or five times a month; usually, so far as I have been able to ascertain, one doctor will not undergo the diagnosis-narcosis with *Virola*-snuff more than once a month. All reports would seem to indicate that it is a dangerous narcotic.

## VII.

The use of a snuff commonly called *paricá* has been known for a century or more, and the source of the narcotic has quite generally been attributed to the leguminous tree *Piptadenia peregrina*. This tree has long been recognized as the source of a violently narcotic snuff which is employed by the natives of the Caribbean area and of northern South America, including the basin of the Río Orinoco, and which is widely called *yopo* or *niopo*. Humboldt's account of this snuff (Humboldt: "Voyages aux régions équinoxiales du nouveau continent. . ." 2 (1819) 260) referred to the preparation and utilization of the drug which he had observed in 1802 amongst the Otomaco and Guahibo Indians of the Orinoco in Venezuela and Colombia: "Ex seminibus tritis calci vivae admixtis fit tabacum nobile quo Indi Otomacos et Guajibos utuntur." The plant used was identified as *Acacia Niopo*, now considered a synonym of *Piptadenia peregrina*.

Sir Robert Schomburgk, who first explored British Guiana from 1835 to 1839, referred the narcotic *paricá* or *paricaraná* to *Mimosa acacioides* Benth. (Schomburgk: "Travels in British Guiana" [transl. W. E. Roth] 1 (1922) 92). This binomial is a synonym of *Piptadenia peregrina*.

In June 1854, during his botanical explorations in the vicinity of the cataracts of the Río Orinoco at Maipures, Richard Spruce came upon a wandering group of Guahibo Indians from the Río Meta in Colombia preparing *yopo*-snuff. He described the preparation of the narcotic and attributed it (as *P. Niopo*) to *Piptadenia peregrina* (Spruce, R. [ed. A. R. Wallace] "Notes of a botanist on the Amazon and Andes" 2 (1908) 427), and he reported the common name as *niopo* in Venezuela and *paricá* in Brazil.

Bates, who worked in the Amazon at the same time

as Spruce, reported, but without the support of botanical material, that *paricá* was prepared from a species of *Inga* (Bates, H. W.: "A naturalist on the River Amazon" 1 (1863) 331).

Carl F. P. von Martius (Zur Ethnographie Amerika's sumal Brasiliens" (1867) 390) stated that the Mundurukú Indians of Brazil used *paricá*, a snuff from the "seeds of *Mimosa acacioides*", having borrowed the habit from their neighbors, the Múras and Mauhés. He also (*loc. cit.* 441, 631) asserted that the Omaguas of Peru use this same snuff, and that it was well known amongst the Paravilhanas of the region north of the Rio Negro in Brazil and in British Guiana.

The German ethnologist Koch-Grünberg, who carried out very extensive investigations in the upper Rio Negro and lower Apaporis basins from 1903 to 1905, similarly attributed the *paricá* of this area to *Mimosa acacioides* (Koch-Grünberg, T.: "Zwei Jahre unter den Indianern" 1 (1909) 323). There seems to be no evidence that material for botanical determination supports his identification, which may have been advanced by Koch-Grünberg because of the extreme similarity of the snuff to the already widely known *yopo*-snuff. Koch-Grünberg reported:

> It is a grey snuff with strong narcotic properties, known in Lingoa Geral as *paricá* and prepared from the dried seeds of a species of *Mimosa*. It is kept in small rounded calabashes or in snail-shells, the opening of which usually is closed with a piece of mirror imbedded in pitch and which, as in the case of the calabash, has a bird-bone spout fixed with pitch. . . Snuffing is done through a forked instrument made of two communicating bird-bones, which are glued together with pitch. . . In using it, a bit of the powder is poured from the snuff-box into the palm of the hand and is scooped up into the bird-bone. Then the end of one of the bones is inserted into the nostril, and the other is put into the mouth. With short blows, the fine powder is injected to the furthest membranes of the nose.

In a footnote, Koch-Grünberg (*loc. cit.*) gives a speci-

fic identification, and he makes an observation which might indicate that he had assumed that this identification must be the correct one, even though he had no botanical specimens:

*Mimosa acacioides* Benth. This snuff is distributed over a great part of tropical South America, from the Orinoco and the Guianas to the southern affluents of the Amazon River. Likewise, the instruments which are used in taking the snuff are very similar.

Somewhat later, Whiffen (Whiffen, T.: "The North-west Amazonas" (1915) 143) reported that:

The Tuyuka and other tribes north of the Japurá use as a stimulant *paricá* or *niopo*, a wonderful snuff which is a strong narcotic and very similar in its effects to coca. It is made from the dried seeds of a mimosa, and like coca, is mixed with quicklime and baked clay. The seeds are roasted and then pounded in a shallow wooden mortar, and the snuff, when made, is packed in snail-shells and is inhaled through hollow bird-bones inserted in both nostrils.

It would appear that this reference of Whiffen (who never visited the Tuyuka country) to the snuff used by the tribes north of the Caquetá (Japurá) may be based upon Koch-Grünberg, for in speaking of the Andoke and Karihona tribes, he wrote (*loc. cit.*):

They all use tobacco-juice, coca, and a white snuff that I thought must be the famous *niopo* but could not find out anything about it.

My own assumption would be that this "white snuff" is actually nothing but tobacco-snuff, which is widely used in the upper Amazon area, where it is always a greyish preparation, because of the large amount of ash mixed with the pulverized tobacco. It cannot be the myristicaceous snuff, for even after the admixture of ashes, this is of a brownish color. Furthermore, the use of the *Virola*-snuff is restricted to a few practitioners and is not permitted to all members of the tribe.

Recently, Mr. Paul H. Allen, who was engaged during 1944 in botanical work in the region of the Vaupés River and its affluents, reported (Allen, P. H.: "Indians

of southeastern Colombia" in Geogr. Rev. 37 (1947) 579) that the Kubeo Indians of the Kuduyarí River employ *paricá*. He gives as the source of *paricá* the leguminous *Piptadenia peregrina:*

> The powdered seeds of *paricá* (*Piptadenia peregrina*) are blown forcefully through a bone into the nostrils of the *payé*, producing a sort of ecstasy, during which he determines the guilty party [i.e. enemies who have sent sickness through the air].

In a letter (January 14, 1952), answering my query as to his designation of the source of the snuff, Allen writes me that he did not see the seeds of *Piptadenia* himself; that he had been informed that seeds were used in the area; and that, on the basis of the literature, he concluded that these represented *Piptadenia peregrina.*

It would seem, therefore, that there is much confusion of *paricá* with *yopo*. This stems primarily from Spruce's account, for he recorded (*loc. cit.* 427):

> I first gathered specimens of the *paricá* (or *niopo*) tree in 1850, near Santarém, at the junction of the Tapajóz and Amazon, where it had apparently been planted. In the following year, I gathered it on the little river Jauouarí—one of the lower tributaries of the Rio Negro—where it was certainly wild. But I did not see the snuff actually prepared from the seeds and in use until June, 1854, at the cataracts of the Orinoco.

We know that Spruce was aware of Humboldt's report of *yopo*-snuff. Upon finding the same tree in an area such as the Rio Negro where, according to local reports, the medicine-men took a snuff called *paricá*, it is possible that Spruce assumed that *Piptadenia peregrina* was also the source of the *paricá*-snuff. This is not an easy explanation to accept, for Spruce deservedly enjoys the reputation of one of the most critical and accurate of ethnobotanical students of South America. Nor are we at all certain to this date that *paricá* does *not* refer to snuff made with *Piptadenia* seeds in *some* parts of the Amazon Valley. Furthermore, we have the reports of

## EXPLANATION OF THE ILLUSTRATION

PLATE XLI. Stripping bark from VIROLA CALOPHYLLA for the preparation of *yakee*-snuff. Rio Apaporis, Comisaría del Amazonas, Colombia.

*Photograph by* RICHARD EVANS SCHULTES

# Plate XLI

## EXPLANATION OF THE ILLUSTRATION

PLATE XLII. (*Top*) A photograph of the inner surface of the bark of VIROLA CALOPHYLLA (*Schultes & Cabrera 12855*), showing the red resin-like exudation which is elaborated into *yakee*-snuff. Río Apaporis, Comisaría del Amazonas, Colombia.

(*Bottom*) The thick syrup resulting from the boiling of the scrapings of the inner bark of VIROLA CALOPHYLLA is allowed to dry before being pulverized and mixed with ashes of THEOBROMA SUBINCANUM in the preparation of *yakee*-snuff. Río Apaporis, Comisaría del Amazonas, Colombia.

*Photographs by* RICHARD EVANS SCHULTES

# Plate XLII

Koch-Grünberg stating that the narcotic snuff of the northwest Amazon is derived from a legume. Nevertheless, we must emphasize Spruce's own words that he "*did not see the snuff actually prepared from the seeds and in use. . .*" in the Rio Negro area.

Some of the records of a narcotic snuff from the Amazon Valley might actually refer to *Piptadenia*, as, for example, Herndon's report (Herndon, W. L.: "Exploration of the Valley of the Amazon" (1854) 319), which he attributed to a trader of snuff amongst the Mundurukú Indians of the Rio Tapajóz. This snuff is reported to be made from powdered seeds, not from bark, which would suggest *Piptadenia* and not *Virola*. But, the Munduruku *paricá* is composed of several constituents:

> Several vegetable substances compose *paricá:* first, the ashes of a vine that I cannot class, not having been able to procure the flowers; second, seeds of the *Acacia angico* of the leguminous family; third, juice of the leaves of the *abuta* (cocculus) of the menispermes family.

In the twelve years which I have devoted to the study of the flora of the northwest Amazon, I have never seen *Piptadenia peregrina* either cultivated or wild in the area. I have never seen any snuff prepared from leguminous seeds in this area, nor have I heard of the practice which appears, in Colombia, to be confined to the Orinoco basin. The Puinaves, who live on the Inirida and Guaviare, where Amazon and Orinoco tribes meet, are acquainted with *both* the myristicaceous and the leguminous snuff and are quick to distinguish between the two.

Whether or not *paricá*-snuff is prepared from a leguminous plant in some parts of the Amazon, it is quite definite that the term *paricá* in most parts of the lower Amazon does refer to certain trees of the *Leguminosae*. *Paricá* is employed in Brazil to denote *Cassia fastuosa* Willd., *Cedrelinga catenaeformis* Ducke, *Parkia* spp., *Piptadenia* spp., *Pithecolobium* spp., *Schizolobium ama-*

*zonicum* (Hub.) Ducke, *S. parahybum* (Vell.) Blake, and *Senegalia* spp. Numerous derivative terms, such as *paricá branca*, *paricá de cortume*, *paricá da terra firme*, *paricá grande da terra firme*, *paricá da varzea*, *paricaraná* and *paricazinho* are likewise applied to species of the *Leguminosae* (Record, S. J. & R. W. Hess: "Timbers of the New World" (1943) 242 ff.; Le Cointe, P.: "Arvores e plantas úteis," ed. 2 (1947) 387 ff.; Ducke, A.: "As leguminosas da Amazônia brasileira" (1939) 164–165; Penna, M.: "Diccionario brasileiro de plantas medicinais" ed. 3 (1946) 295; Huber, J. in Bol. Mus. Para. Hist. Nat. Ethnog. 6 (1909) 213).

The only pronouncements which we can, at this moment, make are (1) that *the paricá of the Rio Negro-Vaupés basin is prepared from the bark of certain species of the myristicaceous genus Virola and not from the seeds of the leguminous genus Piptadenia;* and (2) that *Piptadenia-snuff or yopo is (at least, at the present time) probably unknown and most certainly not employed in this area.*

As the foregoing discussion has pointed out, the identification of the botanical sources of South American narcotic snuffs in general and of those called *paricá* in particular is in a state of extreme confusion. To a great extent, this is directly attributable to the habit, in anthropological and geographical articles, of using the common names and of depending upon common names and not botanical material for plant identification. This has been most forcefully emphasized in a recent and excellent summary of our knowledge of stimulants and narcotics of the South American Indians, in reference to the various snuffs attributed to *Piptadenia* (Cooper, J. M.: Bur. Amer. Ethnol. Bull. 143 (1949) 536, map 10):

Our tribal records on which the above list and accompanying distribution map (map 10) are based are probably very incomplete. On the other hand, some of the attributions may not be correct, since in some cases the lack of exact botanical identification makes it doubtful

whether we have to do with *Piptadenia* snuff, tobacco snuff, or snuff from some other plant—as, for instance, the 'topsayri' in early Peru —or from an unidentified tree bark among the Yecuaná. . .

There is, in this problem of the identity of *paricá*, a most curious phase which is, as yet, apparently far from solution.

In the kits which contain the witch-doctor's paraphernalia amongst certain tribes on the Río Vaupés and the upper Río Piraparaná, there is always a lump or two of a clear yellow amber-like resin. This is used as a snuff, but seems to have no narcotic properties. Before a "diagnosis", the medicine-man rasps a small amount of this resin and pulverizes it finely, after which it is taken into the nostrils. The resin, when powdered, is slightly aromatic. It is my belief that the use of this resin as a snuff is related perhaps to a kind of "purification", preparatory to making a diagnosis, but we have very little information about it. I suspect that the source of the resin might be a species of *Clusia*, but I have no personal observations to offer in support of this suspicion. There is the barest of possibilities that the resin might be of myristicaceous origin, for we recall that *Myristica Bicuhyba* Schott of Brazil yields a balsam which is sometimes substituted for copaiba (*Copaifera officinalis* L.), (Kraemer, H.:" Scientific and applied pharmacognosy" (1915) 250). There is no actual evidence, however, for such a belief.

I have seen these lumps of *paricá* amongst the Barasana Indians of the Caño Tee-mee-ña, an affluent of the Río Piraparaná. It was impossible to procure material or a description of either its preparation or of the source tree—but we know that it is procured from a large tree of the forest.

Two of my colleagues, who spent long periods in the Colombian Vaupés, have likewise encountered this ele-

ment of the local doctor's kit. Mr. Paul H. Allen (in litt., January 14, 1952) has written the following information to me:

> *Payé* [witch-doctor] kits seen in the Bajo Vaupés, but particularly from the lower Querarí and vicinity, contained lumps of an amber gum, which local people told me was the active principle of *paricá*. I doubted it very strongly, and the *payés* were far too suspicious and resentful of my collecting activities to be very communicative, much less to be willing to stage a demonstration.

Dr. Lothar Petersen, a physician in Bogotá who spent many months in medical studies amongst the Indians of the Vaupés, likewise found these lumps of resin and reports that it is known locally as *paricá*. He procured several lumps from a witch-doctor in the headwaters of the Río Piraparaná, but he also was unable to learn the tree from which the resin was obtained. Dr. Petersen has kindly given me two small lumps which will be studied chemically in an attempt to ascertain their approximate composition and, thus indirectly, perhaps to discover their botanical source.

It is clear from the problems raised in the present paper that much botanical work still must be carried on in our study of narcotic and stimulant plants in the Amazon Valley. It is hardly believable that such a widely used and virulent narcotic snuff as *yákee* would have to wait until this late date in the history of botanical exploration of the Amazon for identification. It makes one wonder how many more narcotic plants, up to now obscured by better-known ones, still wait to be discovered.

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# THE ORIGIN AND POSSIBLE EVOLUTION OF SUB-TASSEL EARS IN MAIZE

BY

WALTON C. GALINAT[1]

MODERN maize has many vestiges which may reflect primitive characteristics of wild maize and its relatives. One of the least mentioned and possibly most significant rudiments in modern maize is the remains of a spathe subtending the lowermost tassel branch or pair of tassel branches. Anderson (1951) has described this vestige as "a kind of little ridge or scar as if a leaf had started to grow out and then had been pulled off." Sometimes this spathe is well-developed and associated with a small sub-tassel ear, as is evident in at least two published illustrations (Häckel, 1887; Weatherwax, 1916—fig. 10). Such an ear near the base of the tassel may be derived from a single staminate spikelet (Weatherwax, 1925).

An examination of over 1000 tassels from varieties of maize from North, Central and South America in the Maize Herbarium of Dr. Paul C. Mangelsdorf revealed a series of types ranging from a reduced and sometimes adnate spathe subtending the lowermost tassel branch to a fully developed leaf borne at a node with a small sub-tassel ear. The adnate or vestigial spathe and its derivations were found in over 70 per cent of the population studied. Sub-tassel spathe development was especially

[1] Research Fellow at the Bussey Institution of Harvard University.

frequent and pronounced in varieties from Bolivia and Peru. This feature is enhanced by tassel proliferation resulting from unfavorable photoperiods during floral differentiation of short-day maize and is also characteristic of tunicate, corn-grass and teopod maize. Tassels which were proliferated or associated with any of the above variants were excluded from this study.

Specimens of *Tripsacum* and *Euchlaena* from the Economic Herbarium of Oakes Ames were examined in an attempt to determine if this rudimentary spathe might be derived from introgression with these near relatives of maize. It was found that in *Tripsacum pilosum*, *T. lanceolatum*, *T. dactyloides* and *T. fasciculatum* there is a small ridge encircling the base of the inflorescence. In these species, with *T. dactyloides* as a possible exception, the ridge is more in the nature of a fracture line for the lowermost rachis-fruit case than that of a vestigial leaf. In *Euchlaena mexicana* there is often a small leaf-like protrusion subtending the lowermost tassel branch. This structure is probably a vestigial spathe since its homologue subtending a lateral pistillate spike is a well-developed spathe. The degree of development of the spathe subtending the tassel of *Euchlaena* appears to be, on the average, intermediate between that of *Tripsacum* and that of maize.

In modern maize, partial development of the subtassel spathe and its axillary branch is usually associated with various anomalies. Both the spathe and its axillary peduncle may be adnate to the rachis. The peduncle may adhere to the rachis over a greater distance than its subtending spathe (Figs. 1–3). The auricles of the spathe may be greatly elongated on either side of a reduced blade (Figs. 4–6). Development of the spathe may be unilateral in relation to the branch, so that it appears as if its blade had been cleaved down the midrib and torn

off on one side (Figs. 7–9). Various twisted configurations may distort the spathe, rachis, and peduncle as the branch tends to become opposite rather than adjacent to its associated spathe (Figs. 10–13). If the axillary branch develops to one side of, or on the opposite side of, the node at which a terminal leaf would normally be expected, then both spathe-leaf and branch may achieve optimum development (Fig. 14). Two leaves, or a leaf and a sheath (husk), may be borne at this node. Such a pair of leaves (Figs. 15, 17) may have a common origin (Figs. 7–9), although distortion of the node may cause them to appear as being separated by a short and twisted internode (Fig. 13). In extreme cases of spathe development, a single spikelet or the tassel branch as a whole may be modified to form a small shank terminated by a small ear (Figs. 15 17). The morphological change from either a spikelet or tassel branch to a many-ranked ear involves a change from bilateral to radial symmetry. Such a transformation is common in maize. Depauperate ears frequently exhibit reductions from a radial to a bilateral condition. One might expect that, if there were a reduction during evolution of a leaf terminal to the culm, then there might also be a corresponding reduction of its axillary ear to a bilateral tassel branch.

Archaeological remains have been found which suggest that sub-tassel ear development may have been characteristic of primitive maize (Mangelsdorf, 1954 and unpub.). This evidence, so far as it goes, indicates that the tassel of wild maize was unbranched or sparsely branched and bore a few pistillate spikelets basally. The spathe subtending the tassel may have had a protective function for these pistillate spikelets during the prepollination period. Subsequent to pollination, rapid elongation above the sub-tassel node might elevate the mature grain for dispersal. Mangelsdorf has suggested (unpub.)

## EXPLANATION OF THE ILLUSTRATION

PLATE XLIII. 1, 2, 3, profile, front and rear views respectively, of the divergence point of the lowermost peduncle from the rachis and its subtending spathe-rudiments which are adnate to the rachis. Natural size.

4, 5, 6, as in previous figures, with the addition of abnormally elongated auricles to an otherwise inhibited spathe. Natural size.

7, 8, 9, as in previous figures, showing cleavage of the spathe followed by unilateral development. Natural size.

10, 11, 12, as in previous figures, except for the equal development of the rudimentary parts of the spathe. Natural size.

13, unilateral spathe development at a twisted and elongated node. One half natural size.

14, tassel branch development on the opposite side of the node from its associated spathe. One half natural size.

15, sub-tassel ear development from a modified sessile staminate spikelet. Two leaves, probably of common origin, are borne at this node. One half natural size.

16, sub-tassel ear borne opposite a leaf at the same node. One half natural size.

*Drawn by* WALTON C. GALINAT

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## EXPLANATION OF THE ILLUSTRATION

PLATE XLIV. 17, photograph of a sub-tassel ear of similar nature to that shown in Fig. 15.

*Photograph by* PAUL C. MANGELSDORF

# Plate XLIV

that such a little sub-tassel ear, borne opposite this spathe, may have attracted man to domesticate an otherwise earless form of primitive wild maize. The present variability in development of this sub-tassel ear or its rudiments might be attributed to its presence in only one or a few of several geographical races of wild maize. It may have also been variable in its expression in wild maize, perhaps dependent on growing conditions.

The frequent adnation of the sub-tassel spathe and its axillary peduncle to the rachis may be another indication of the important role that adnation has played in the development of the inflorescence and plant of maize. The cupule, a structure in maize associated with the attachment point of a pair of pistillate spikelets to the rachis, has probably been formed by a prophyll adnate to the rachis (Nickerson, 1954).

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# BOTANICAL MUSEUM LEAFLETS
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# ON THE ORIGIN OF OATS


BY

DEXTER R. SAMPSON


## INTRODUCTION

MAN has long been interested in the origin of his cultivated plants, for they are the foundations upon which his various civilizations have been built. Primitive peoples frequently regarded their plants as gifts of the gods, but modern man seeks more natural explanations, both to satisfy his curiosity and to provide a sound basis for plant improvement projects.

The present paper is an attempt to bring together the available evidence on the origin of oats, the world's fourth most important cereal crop (Stanton, 1953). It is proposed to attack the problem by reviewing: the several systems of classification of the genus *Avena* L., together with the geographical distributions of the species; the cytological and genetical interrelations; and finally, the impact of man upon the genus.


The author wishes to acknowledge his indebtedness to Elizabeth Alden and Tatiana Taitschevsky who translated Russian references and to Drs. Albert F. Hill and Paul C. Mangelsdorf for their valuable criticisms and suggestions.


## PART I. CLASSIFICATION AND DISTRIBUTION

The genus *Avena* is generally considered as consisting

of two sections: *Euavena* Griseb., which contains the cultivated oats and related wild annuals; and *Avenastrum* C. Koch, which comprises about forty species of wild perennials, most frequent in northern Eurasia, but with two species native to western North America. By recent authors (Hitchcock, 1950; Clapham et al., 1952) the section *Avenastrum* is treated as the genus *Helictotrichon* Besser. In the present paper only the section *Euavena* will be considered.

### *Natural Systems of Classification*

Three students, Cosson (1854), Thellung (1911) and Mal'tsev (1929), have each attempted to devise a natural classification for the section *Euavena*.

Cosson divided the section into subsection *Sativae* containing the cultivated species, and subsection *Agrestes* containing the wild. This division is based on the fact that the spikelets of the cultivated species are firmly attached to the rachilla and do not fall at maturity, whereas the spikelets of the wild species are articulated to the rachilla and fall spontaneously when ripe. Cosson further divided the *Agrestes* into the series *Biformes* in which only the lower floret is articulated so that the spikelet falls as a unit, and the series *Conformes* with all florets articulated and falling separately. The disposition of species by Cosson is:

Subsect. I. *Sativae*
*A. sativa, A. orientalis, A. strigosa, A. brevis, A. nuda*
Subsect. II. *Agrestes*
Series 1. *Biformes*
*A. ventricosa, A. sterilis, A. eriantha*
Series 2. *Conformes*
*A. longiglumis, A. clauda, A. hirsuta, A. fatua*

The system of Thellung is based on the assumption that each of the cultivated species is related to and derived from some wild species. Accordingly the *Sativae*

of Cosson are distributed between the *Biformes* and *Conformes*. Unfortunately several wild species are not considered. The disposition of species by Thellung is:

Subsect. I. *Biformes*

*A. sterilis* ssp. 1 *macrocarpa*
ssp. 2 *byzantina*

Subsect. II. *Conformes*

*A. fatua* ssp. 1 *fatua*
ssp. 2 *sativa* (incl. *A. orientalis*)
ssp. 3 *nuda*

*A. strigosa* ssp. 1 *barbata*
ssp. 2 *strigosa* (incl. *A. brevis*)
ssp. 3 *Wiestii*
ssp. 4 *abyssinica*

The system of Mal'tsev was developed after an extensive study of herbarium material and of a series of plantings of *Avena* species in various parts of the U.S.S.R. The material was gathered by the expeditions of Vavilov and associates, the geographical and ecological data collected by the expeditions being used in the treatment. On the basis of chromosome numbers Mal'tsev divided the section into subsection *Aristulatae* and subsection *Denticulatae*. Subsection *Aristulatae* contains the diploid and tetraploid species. It is regarded as the older, perhaps derived from section *Avenastrum*, with its center of origin in the western part of the Mediterranean region. Subsection *Denticulatae* contains the hexaploid oats and is believed to be the younger. It is regarded as having arisen from an unknown ancestral complex in the mountains of Central Asia, a conclusion which Schiemann (1932) says has not been shown to be based on fact. The characters used by Mal'tsev to define his subsections and series will be given in the key. In the following outline of the system all cultivated oats are marked by asterisks and each is believed to be derived from the wild subspecies which immediately precedes it. The division into

chromosome groups is provided for the convenience of the reader and is not part of Mal'tsev's system.

Subsection I. *Aristulatae*
Diploid Group 2n = 14
Series 1. *Inaequaliglumes*
1. *A. clauda*
2. *A. pilosa*
Series 2. *Stipitatae*
3. *A. longiglumis*
4. *A. ventricosa sens. ampl.*
ssp. 1. *ventricosa*
2. *Bruhnsiana*
Series 3. *Eubarbatae*
5. *A. strigosa sens. ampl.*
ssp. 1. *hirtula*
2. *strigosa**
Tetraploid Group 2n = 28
ssp. 3. *barbata*
4. *Wiestii*
5. *Vaviloviana*
6. *abyssinica**
Subsection II. *Denticulatae*
Hexaploid Group 2n = 42
6. *A. fatua sens. ampl.*
ssp. 1. *septentrionalis*
2. *nodipilosa**
3. *meridionalis*
4. *macrantha**
5. *fatua*
6. *sativa**
7. *cultiformis*
8. *praegravis**
7. *A. sterilis sens. ampl.*
ssp. 1. *Ludoviciana*
2. *pseudo-sativa**
3. *trichophylla*
4. *nodipubescens**
5. *macrocarpa*
6. *byzantina**

In the present paper, following Mordvinkina (1936), binomials are restored to several of the taxa treated as subspecies by Thellung and Mal'tsev. This is scarcely justifiable in the case of *A. strigosa sens. ampl.* which seems to form a unified although poorly understood group. The division of subsection *Denticulatae* into the traditional four species is also questionable, it being probable that these oats comprise but one highly polymorphous species. The present treatment follows common practice and is justifiable only for the sake of convenience.

## *Key for the Determination of Species*

(largely after Mordvinkina, 1936)

A. Lemma usually ending in two slender awns; plants mostly slender. (Subsect. *Aristulatae* Malz.)
  B. Glumes very unequal, upper almost twice as long as lower; 2n = 14 (Series *Inaequaliglumes* Malz.)
    C. All florets of spikelet articulated, falling separately at maturity *A. clauda*
    C. Only lower floret articulated, spikelet falling as a unit *A. pilosa*
  B. Glumes equal or subequal
    D. Callus 5–10 mm. long, subulate; 2n = 14 (Series *Stipitatae* Malz.)
      E. All florets articulated *A. longiglumis*
      E. Only the lower floret articulated
        F. Callus ± 5 mm. long; glumes 25–30 mm. long *A. ventricosa*
        F. Callus to 10 mm. long; glumes to 40 mm. long *A. Bruhnsiana*
    D. Callus about 2 mm. long; 2n = 14 or 28 (Series *Eubarbatae* Malz.)
      G. Lemma ending in 2 awns and having 1 or 2 lateral teeth; glumes with 7–9 nerves
        H. Lemma with 1 lateral tooth (sometimes none); awns at tip of lemma usually exserted beyond the glumes
          I. Florets articulated, articulation-scar oblong-linear; awns at tip of lemma to 12 mm. long *A. hirtula*
          I. Florets not articulated; awns 1–5 mm. long *A. strigosa*

H. Lemma with 2 lateral teeth; awns not exserted
J. Florets articulated, scar oval or round
K. Awns at tip of lemma 3–6 mm. long
*A. Wiestii*
K. Awns ± 1 mm. long *A. Vaviloviana*
J. Florets not articulated; awns 1–4 mm. long
*A. abyssinica*
G. Lemma ending in 2 awns to 5 mm. long, lateral teeth wanting; glumes with 9(10) nerves; articulation-scar oblong *A. barbata*

A. Lemma usually ending in two small teeth, never produced into two setiform awns; plants mostly robust; 2n = 42 (Subsect. *Denticulatae* Malz.)
L. Lower floret articulated with the rachilla
M. Upper florets not articulated, spikelet falling as a unit
*A. sterilis*
M. All florets articulated *A. fatua*
L. None of the florets articulated, separated by fracture of rachilla
N. Most of rachilla segment remains attached to upper floret on threshing; fracture surface at base of lower floret slanting
*A. byzantina*
N. Rachilla segment remains attached to lower floret; fracture surface not slanting *A. sativa*

*Distribution and Relationships of Avena Species*

1. **A. clauda** *Dur.* A wild oat found in Algeria (Battandier and Trabut, 1904), Tripoli, Palestine (Post, 1933), Asia Minor, Iraq, Transcaucasia and eastward to Turkistan (Mal'tsev, 1929). Reported as rare in Attica, Greece (DeHalácsy, 1904).

Mal'tsev says this species more closely resembles the genus *Helictotrichon* than any other *Avena* species. He therefore considers it to be the most ancient, and to have given rise to the remainder of the *Aristulatae* through *A. longiglumis.*

2. **A. pilosa** *M. Bieb.* A wild oat occurring in northern Algeria (Battandier and Trabut, 1904), Tripoli, Syria (Post, 1933), Asia Minor, the Caucasus and eastward to southern Turkmenistan (Mal'tsev, 1929).

Battandier and Trabut, and Mordvinkina (1936) state that only the lower floret of *A. pilosa* is articulated, while Post (1933) says that none of the florets are jointed to the axis. Haussknecht (1894), according to Thellung (1911), noted the same variation and believed this species to be a variety of *A. clauda*, differing only in the manner of floret attachment. Mal'tsev treats *A. pilosa* as closely related to and derived from *A. clauda* by a side branch of the main phylogenetic trunk. Both species, according to him, have unequal glumes, a linear callus about 3 mm. long and a linear-elliptical articulation-scar.

3. **A. longiglumis** *Dur.* A wild oat found in southern Spain (Willkomm and Lange, 1870), Algeria (Battandier and Trabut, 1904), Palestine (Post, 1933) and Greece (DeHalácsy, 1904). Mal'tsev believes it to have given rise to *A. ventricosa* on the one hand, and to *A. strigosa sens. ampl.* on the other.

4. **A. ventricosa** *Bal.* A wild oat restricted to western Algeria (Battandier and Trabut, 1904; Mal'tsev, 1929). Mal'tsev derived this species from the preceding by a side branch of the main phylogenetic trunk. It resembles *A. longiglumis* in having equal glumes and a long callus with a narrow linear scar. It differs in having only the lower floret articulated, as in *A. pilosa*.

5. **A. Bruhnsiana** *Grun.* A wild oat restricted to the Apsheron Peninsula in eastern Transcaucasia, and treated by Mal'tsev as a subspecies of *A. ventricosa* from which it differs by the larger size of its spikelet-parts. Although the two are now separated by some 2500 miles, we do not know what migrations they may have undergone in the past. The wide gap is partially spanned by *A. longiglumis* from which they may have evolved independently.

6. **A. hirtula** *Lag.* = *A. strigosa* Schreb. ssp. *hirtula* (Lag.) Malz. A wild oat which is restricted to the western portion of the Iberian Peninsula (Mordvinkina, 1936). According to Thellung (1911) and Mal'tsev (1929), *A. hirtula* is intermediate in its characters between *A. Wiestii* and *A. barbata*. Mal'tsev derives the remaining diploid and tetraploid oats from this species.

7. **A. strigosa** *Schreb.* = *A. strigosa* Schreb. ssp. *strigosa* (Schreb.) Thell. The hairy or sand oat occurs as a weed throughout northwestern Europe from Portugal to southern Finland (Vavilov, 1926; Werth, 1944). Thellung reports it as sometimes cultivated on sandy soils in Portugal and Spain, western and central France, Belgium, northwestern Germany and Great Britain. Vavilov says it is only met with as a crop in France and Great Britain. In England it is rare and local, being found only as a weed in grain fields (Clapham et al., 1952), while Stanton (1936) reports that an improved strain has been developed in Wales. *A. strigosa* has two variants which are sometimes called species and sometimes proles (races). These are *A. brevis* and *A. nudibrevis*.

*A. brevis* Roth = ssp. *strigosa* prol. *brevis* (Roth) Hausskn. The short oat, like the typical *strigosa*, is adapted to unfavorable soil conditions and is sometimes cultivated in Portugal, Spain, France and northwestern Germany (Thellung, 1911). It is distinguished by its blunt lemmas which end in two teeth rather than in two awns.

*A. nudibrevis* Vav. = ssp. *strigosa* prol. *nuda* (L.) Hausskn. = *A. nuda* L. var. *biaristata* Asch. & Gr. The small-grained naked oat is occasionally cultivated in northwestern Germany (Vavilov, 1926). *A. nudibrevis* differs from the typical *strigosa* in having lemmas which do not become indurated at maturity, but remain membranous allowing the loosely enclosed grains to be readily threshed

free. It was once thought that all naked oats (the so-called species *A. nuda* L.) came from China where hexaploid naked oats are widely grown. The cytological work of Nikolaewa (1922) revealed that the small-grained naked oat was a diploid and undoubtedly European in origin. Later Mal'tsev showed *A. nuda* to be a highly diverse assemblage, containing, in addition to the present oat, four proles belonging to *A. sativa* and one to *A. byzantina*.

*A. strigosa* and its variants are the only diploid cultivated oats and are geographically isolated from all other diploids except *A. hirtula*. Mal'tsev derived *A. strigosa* from *A. hirtula*, a judgment sounder than those of Thellung (1911, 1928) and Trabut (1914) who suggested the tetraploid *A. barbata* had given rise to *A. strigosa*. De Candolle (1883) stated that *A. strigosa* appeared to be a form of *A. sativa*, so subtle are the differences between the various cultivated oats.

8. **A. Wiestii** *Steud.* = *A. strigosa* Schreb. ssp. *Wiestii* (Steud.) Thell. A desert plant which is widespread in North Africa (Trabut, 1914), Egypt (Täckholm et al., 1941), Syria and Palestine (Post, 1933), Iraq and rare in eastern Transcaucasia (Mal'tsev, 1929).

It is possible that both diploid and tetraploid oats exist which answer the description of *A. Wiestii*, but this will be considered later. Mal'tsev treats it as a tetraploid. Thellung (1911) and Trabut (1914) suggest that *A. Wiestii* is the wild species from which *A. abyssinica* has been derived, and in 1928 the former gave six transitional forms between the two.

9. **A. Haviloviana** (*Malz.*) *Mordv.* = *A. strigosa* Schreb. ssp. *Haviloviana* Malz. = ? ssp. *Wiestii* (Steud.) Thell. var. *pseudo-abyssinica* Thell. A wild oat restricted to Abyssinia and Eritrea (Mal'tsev, 1929).

*A. Vaviloviana*, which scarcely deserves the rank of species, appears to be a short-awned variety of *A. Wiestii*. It is regarded by Mal'tsev as the wild oat from which *A. abyssinica* has been derived.

10. **A.abyssinica** *Hochst.* = *A. strigosa* Schreb. ssp. *abyssinica* (Hochst.) Thell. = *A. sativa* L. var. *abyssinica* Engler. This oat is restricted to Abyssinia, Eritrea and Yemen (Mal'tsev, 1929) where it is both cultivated and semi-wild (Vavilov, 1926). Harlan reports (Stanton and Dorsey, 1927) observing it rarely in Abyssinia and only as an admixture in barley fields. The natives informed him they had seeded it in the barley fields intentionally.

*A. abyssinica* is the only cultivated tetraploid oat. It is described by Mal'tsev as having the awn-points at the tip of the lemma reduced to ±1 mm. as in *A. Vaviloviana*. However, Stanton and Dorsey describe plants of this species as having the awn-points 2–4 mm. long. Evidently Mal'tsev was unaware of the range of variation in *A. abyssinica*.

11. **A.barbata** *Pott* = *A. strigosa* Schreb. ssp. *barbata* (Pott) Thell. A wild oat occurring along the Atlantic coast of Europe from Brittany southward, throughout the Mediterranean region (Thellung, 1911) and extending eastward through Transcaucasia and southern Turkistan to Afghanistan and the western Himalayas (Mal'tsev, 1929). *A. barbata* has been introduced into the United States, where it occurs as a common weed from Washington and Oregon to Arizona and California (Hitchcock, 1950).

12. **A. sterilis** *L. sens. ampl. excl. form. cult.* The wild red oat, a hexaploid complex distinguished by the lack of articulation of the upper florets, is an Old World species, ranging from the Atlantic to the Himalayas, and

may be divided into three subspecies: *sterilis*, *trichophylla* and *Ludoviciana*.

Ssp. **sterilis** = ssp. *macrocarpa* (Moench) Briq. A stout plant with large grains, spikelets with 3–5 florets, glumes 30–50 mm. long, culm-nodes glabrous. It is strictly Mediterranean in distribution (Mal'tsev, 1929).

Ssp. **trichophylla** (*C. Koch*) *Malz.* A more slender plant with medium-sized grains, spikelets with 2–3 florets, glumes 25–35 mm. long, culm-nodes pubescent. It shares the easternmost range of ssp. *sterilis* in Palestine, Syria and western Asia Minor, but it extends eastward through Asia Minor to Transcaucasia, western Iran and Iraq (Mal'tsev, 1929). Mal'tsev regards this subspecies as intermediate between ssp. *sterilis* and ssp. *Ludoviciana*.

Ssp. **Ludoviciana** (*Dur.*) *G. & M.*, is a plant with small grains, spikelets with 2 (rarely 3) florets, glumes 25–30 mm. long, and glabrous culm-nodes. It ranges from southern England (Clapham et al., 1952), through France, Switzerland, Italy (Thellung, 1911), Spain (Willkomm and Lange, 1870) to North Africa (Battandier and Trabut, 1904). It is scattered throughout the Mediterranean region and becomes more abundant from Asia Minor through southern Russia, the Caucasus, southern Turkmenistan and northern Iran to Afghanistan and Turkistan (Mal'tsev, 1929). This subspecies, which has the general aspect of *A. fatua*, occurs largely in areas where the ranges of *A. sterilis* and *A. fatua* meet or overlap.

Since the similarities between the two species were pointed out by Trabut (1914), it has been universally believed that *A. byzantina* has been derived from *A. sterilis*. Thellung (1928) has distinguished 15 transitional forms. Recently Coffman (1946) has proposed the theory that *A. sterilis* is the progenitor of all other hexaploid oats.

13. **A. byzantina** *C. Koch*, the cultivated red oat, is grown in southern Spain, southern Italy, Greece, North Africa and Asia Minor (Vavilov, 1926) and in the southern part of the United States, South America, Australia and New Zealand (Stanton, 1953).

*A. byzantina*, distinguished from *A. sterilis* by its non-articulate spikelets, has three subspecies: *byzantina*, *nodipubescens* and *pseudo-sativa*. According to Mal'tsev (1929), these are derived from *A. sterilis* subspecies *sterilis*, *trichophylla* and *Ludoviciana* respectively. Except for the non-articulate spikelets, the subspecies of *A. byzantina* resemble the subspecies of *A. sterilis* from which they are supposedly derived and may be determined accordingly.

Ssp. **byzantina,** the one most commonly cultivated, has the rare naked prol. *denudata* (Hausskn.) Malz. Ssp. **nodipubescens** *Malz.* occurs from Asia Minor to Palestine, while ssp. **pseudo-sativa** *Thell.* has been reported from Switzerland and Uruguay.

That *A. sterilis* has contributed to the formation of *A. byzantina* seems logical on the basis of geography and on the facts that both species are resistant to heat and cold and to many of the ordinary diseases of oats (Coffman, 1946). None of these similarities extends to *A. fatua*, the only other wild hexaploid oat. For the derivation of *A. byzantina* from *A. sterilis* it requires only that the spikelet-articulation of the latter cease to function. Vavilov (1950) placed the center of origin of *A. byzantina* in the Near East.

14. **A. fatua** *L. sens. ampl. excl. form. cult.* is a wild oat with a vast range across Eurasia from the Atlantic to Mongolia. It has been widely introduced into North America and is a troublesome weed in the hard spring wheat areas of Minnesota, the Dakotas, Montana and

adjacent Canada (Stanton, 1936). Thellung (1911) reports it to be adventive in South Africa, South America, Australia and New Zealand. Täckholm et al. (1941) report it from Egypt, Cyrenaica, Tunis, Algeria and Morocco. It may be divided into four subspecies: *meridionalis, septentrionalis, fatua* and *cultiformis.*

Ssp. **meridionalis** *Malz.*, with glumes to 30 mm. long, elongate-lanceolate lemmas to 25 mm. long and mostly glabrous culm-nodes, is the southernmost subspecies, ranging from the mountains of south central Asia through Afghanistan, Iran, Transcaucasia and Asia Minor to Egypt (Mal'tsev, 1929).

Ssp. **septentrionalis** *Malz.*, with glumes to 25 mm., lanceolate lemmas to 20 mm. long and culm-nodes always pubescent, extends from northern Russia and the Ural region through western and central Siberia to the Lake Baikal region and Mongolia, thence southwestward through the mountains of central Asia from the Altai to the Pamir Plateau, the Hindu Kush and the northwest Himalayas.

Ssp. **fatua,** with glumes to 25 mm. long, lanceolate lemmas to 20 mm. long, grains 1.5–2 mm. thick, and culm-nodes always glabrous, is the western subspecies ranging from Turkistan and the Caucasus through southern Russia, Poland and the whole of western Europe.

Ssp. **cultiformis** *Malz.*, with glumes to 25 mm. long, ovate-lanceolate lemmas to 20 mm. long, grains 2 3 mm. thick, and with culm-nodes always glabrous, appears to have no well-defined geographical range. It is reported by Mal'tsev as being most common in North America, but occurring also in Europe eastward to central Russia.

*A. fatua* is generally believed (Thellung, 1911; Trabut, 1914; Mal'tsev, 1929) to be the progenitor of *A. sativa* and Thellung (1928) gave 21 transitional forms. It will be recalled that Thellung (1911) placed *A. sterilis*

and its derivatives in subsection *Biformes* and *A. fatua* with its derivatives in subsection *Conformes*. Similarly Mal'tsev divided the hexaploid oats into two independent species: *A. fatua sens. ampl.* and *A. sterilis sens. ampl.* Coffman (1946), however, is convinced that all hexaploid oats are derived monophyletically from *A. sterilis*, and regards *A. fatua* as an aberrant weed. It must be remembered, however, that it is the cultivated oats, with their lack of floret-articulation, which are "aberrant." *A. fatua*, although a weed, is a perfectly normal self-propagating grass.

15. **A. sativa** *L.*, the common cultivated oat, is widely grown throughout northern Eurasia and in the northern United States and Canada. According to Stanton (1953), it is the most important cultivated oat.

*A. sativa* may be divided into four subspecies: *macrantha*, *nodipilosa*, *sativa* and *praegravis*, derived according to Mal'tsev (1929), from subspecies *meridionalis*, *septentrionalis*, *fatua* and *cultiformis* of *A. fatua* respectively. Except for the non-articulate florets, the subspecies of *A. sativa* resemble the subspecies of *A. fatua* from which they are supposedly derived and may thus be determined.

Ssp. **macrantha** (*Hack.*) *Malz.* occurs as a weed in grain fields over much of the same range as *A. fatua* ssp. *meridionalis*. It has the rare naked prol. *nudata* Malz.

Ssp. **nodipilosa** *Malz.* is cultivated principally in northern Russia, the Ural region, Siberia and Mongolia. It has the naked prol. *decorticata* Malz. which is cultivated in Mongolia and northern China.

Ssp. **sativa** is the most commonly cultivated oat. It has the naked prol. *chinensis* (Fisch.) Malz. which is sometimes grown in Europe and North America.

Ssp. **praegravis** (*Krause*) *Malz.* is cultivated principally in southern Russia, Europe and North America.

Its naked prol. *grandiuscula* Malz. is sometimes grown in Europe and North America.

The so-called *A. orientalis* Schreber is any form of *A. sativa* with a condensed, one-sided panicle, a not infrequent variation.

The similarity between the ranges of *A. fatua* and *A. sativa*, which extends to the subspecies, suggests a close relationship between the two, as does the parallel variation of the subspecies. The morphology of the spikelets of the two species also suggests a relationship, for with *A. sativa*, when the upper florets are separated by fracture of the rachilla, the rachilla segment remains attached to the lower floret exactly as with *A. fatua*, and different from *A. sterilis* and *A. byzantina* where the rachilla segment remains attached to the upper floret. These similarities have previously been interpreted as indicating that *A. sativa* arose from *A. fatua*, but Coffman (1946) has suggested the reverse might be true. Vavilov (1950) placed the center of origin of *A. sativa* in the Near East region.

## *Conclusions*

From the foregoing discussion it seems clear that the diploid species, with the notable exception of *A. strigosa*, have limited ranges in the Mediterranean region, a few also extending into the Near East. The tetraploids occupy the same general area as the diploids, but are better represented in the Near East. *A. Vaviloviana* and *A. abyssinica*, however, are somewhat isolated to the south. The hexaploids *A. sterilis* and *A. byzantina* are largely restricted to the Mediterranean and Near East regions, while *A. fatua* and *A. sativa* extend from those regions far to the north and northeast.

It is also clear that phylogenetic studies have reached an unanimous conclusion on the derivation of the cultivated species only in the case of *A. byzantina*. The interrelationships among the wild species are equally obscure.

## Part II. The Evidence from Cytology

### *Chromosome Numbers*

Following is a list of the chromosome numbers which have been reported for *Avena* species, together with authorities for the counts. The list of authorities is incomplete, but in cases of disputed counts it indicates which count has been verified by several authors.

| | | |
|---|---|---|
| 1. *A. clauda* | 2n = 14 | Nikolaewa, 1922; Emme, 1930. |
| 2. *A. pilosa* | 2n = 14 | Nikolaewa, 1922. |
| 3. *A. longiglumis* | 2n = 14 | Ellison, 1940. |
| 4. *A. ventricosa* | 2n = 14 | Emme, 1930. |
| 5. *A. Bruhnsiana* | 2n = 14 | Emme, 1930. |
| 6. *A. hirtula* | 2n = 14 | Emme, 1930; Ellison, 1940. |
| 7. *A. strigosa* | 2n = 14 | Kihara, 1919; Nikolaewa, 1922; Winge, 1925; Aase and Powers, 1926; Huskins, 1927; Nishiyama, 1929; Emme, 1930; Spier, 1934; Ellison, 1940. |
| 8. *A. Wiestii* | 2n = 14 | Dorsey, 1925; Aase and Powers, 1926; Huskins, 1927; Kihara and Nishiyama, 1932; Spier, 1934; Ellison, 1940. |
| | 2n = 28 | Emme, 1930. |
| 9. *A. Vaviloviana* | 2n = 28 | Emme, 1930. |
| 10. *A. abyssinica* | 2n = 28 | Stanton and Dorsey, 1927; Emme, 1930; Kihara and Nishiyama, 1932; Spier, 1934; Ellison, 1940. |
| 11. *A. barbata* | 2n = 28 | Kihara, 1919; Dorsey, 1925; Huskins, 1927; Nishiyama, 1929; Emme, 1930; Spier, 1934; Ellison, 1940. |
| | 2n = 32 | Nikolaewa, 1922. |
| 12. *A. sterilis* | 2n = 42 | Kihara, 1919; Huskins, 1927; Nishiyama, 1929; Emme, 1930; Spier, 1934. |
| | 2n = 44 | Nikolaewa, 1922. |
| 13. *A. byzantina* | 2n = 42 | Kihara, 1919; Dorsey, 1925; Huskins, 1927; Nishiyama, 1929; Emme, 1930. |
| | 2n = 44 | Nikolaewa, 1922. |
| 14. *A. fatua* | 2n = 42 | Kihara, 1919; Huskins, 1927; Nishiyama, 1929; Emme, 1930. |
| | 2n = 48 | Nikolaewa, 1922. |
| 15. *A. sativa* | 2n = 42 | Kihara, 1919; Winge, 1926; Aase and Powers, 1926; Huskins, 1927; Nishiyama, 1929; Emme, 1930; Spier, 1934. |
| | 2n = 48 | Nikolaewa, 1922. |

The counts obtained by Nikolaewa on the polyploid species differ from those of all other workers and probably represent errors.

The case of *A. Wiestii* is a different matter. Emme (1930), working in conjunction with the taxonomist Mal'tsev, found *A. Wiestii* to be a tetraploid, but stated that an oat from Palestine, which Vavilov said was essentially *A. Wiestii*, was a diploid. The oat found by Spier (1934), Huskins (1927) and Dorsey (1925) to be diploid is described by Stanton and Dorsey (1927) and is said to have been received from Egypt. It also appears to be essentially *A. Wiestii* except for usually having 9-nerved glumes. *A. Wiestii sensu* Mal'tsev has glumes with 7(8) nerves. Similarly *A. barbata* may have both diploid and tetraploid forms. Jones (1940) reports having received many years ago, as an impurity in seed of *A. Wiestii*, an oat which was identified as *A. barbata* until Ellison (1938) found it to be a diploid. This diploid oat goes under the designation of Cc1795. Clearly more work is required before the relationships between the diploid and tetraploid species can be understood.

## *Genome Analysis*

Although the chromosome numbers indicate certain *Avena* species to be polyploids, every cytologist and geneticist who has studied the polyploid species has found them to behave like diploids with complete bivalent formation at meiosis and high fertility. In discussing how this situation came about, Philp (1933) suggested the tetraploids may be auto- or allopolyploids arising from one or two diploid species, while the hexaploids probably arose from a tetraploid and a diploid and so ultimately may have been derived from two or three diploid species. The study of chromosome pairing at meiosis in the $F_1$ hybrids of interspecific *Avena* crosses has shed a certain

amount of light on the origins of the polyploid species, as well as the relationships between species having the same chromosome number.

*Diploid×Diploid*—Genome analyses between diploid *Avena* species have been restricted to the series *Eubarbatae*. The $F_1$ of *A. strigosa brevis*×*A. strigosa* showed normal bivalent formation (Ellison, 1938). The chromosomes of *A. Wiestii* are very similar to those of *A. strigosa*, as Nishiyama (1933) crossed these two species with a synthetic diploid and 7 normal bivalents were observed in the $F_1$ of both crosses.

The chromosomes of *A. hirtula* show slight structural differentiation from those of *A. strigosa*, for in the $F_1$ of *A hirtula*×*A. strigosa brevis* Ellison (1940) found complete pairing in most cells, but 1% of the cells examined showed 6 bivalents and 2 univalents while in many cells 1 bivalent was found to consist of heteromorphic homologues. Greater differentiation is shown by the oat Cc1795 which has been crossed with *A. Wiestii* and *A. strigosa brevis* (Ellison, 1940), and in both cases 5 bivalents and 1 quadrivalent were regularly observed.

The above evidence suggests the chromosomes of *A. strigosa*, *A. Wiestii* and the synthetic diploid are very similar. Nishiyama (1936) has represented the genome of these species as AA. Although showing some differentiation, the genome constitution of *A. hirtula* and Cc1795 appears to be AA also.

*Tetraploid×Tetraploid*—Ellison (1938) observed meiotic behavior in the $F_1$ of *A. barbata*×*A. abyssinica* and found complete bivalent formation in most cells. However, 15% of the cells showed 1 quadrivalent and cells having no quadrivalent sometimes had 2 or 4 univalents or a univalent and a trivalent. Ellison believed this irreg-

ularity to be due to segmental interchange. Otherwise the genome constitution of *A. barbata*, which was represented as AAB′B′ by Nishiyama (1936), seems identical to that of *A. abyssinica*.

*Hexaploid*×*Hexaploid*—Nishiyama (1929) examined chromosome pairing in the $F_1$ of four hexaploid species combinations and found 21 normal bivalents in the majority of cells. Sometimes, however, 1 or 2 bivalents failed to form properly, resulting in univalents, a trivalent or a quadrivalent. Nishiyama suggested these irregularities were probably caused by mating between semi-homologous chromosomes which are not normal partners. Nishiyama expressed the degree of affinity between the genomes of the various species by the ratio of the number of bivalents found in the $F_1$ to the number expected. Full affinity between the parental genomes was given the value of unity, while no affinity was equal to zero. The values obtained by Nishiyama are:

| | | |
|---|---|---|
| *A. fatua* . . . . . | 0.998 . . . . . | *A. sativa* |
| *A. fatua* . . . . . | 0.992 . . . . . | *A. sterilis* |
| *A. sativa* . . . . . | 0.983 . . . . . | *A. byzantina* |
| *A. sterilis* . . . . . | 0.986 . . . . . | *A. byzantina* |

Spier (1934) reported complete bivalent formation in the $F_1$ of *A. sterilis*×*A. sativa*. A few cells damaged by pressure showed two univalents.

Joshi (1951) studied meiotic behavior in the $F_1$'s of crosses involving *A. sativa*, *A. sterilis* and *A. fatua* and found 6–13% of the pollen mother cells showed irregularities, the nature of which was not stated. The parental species showed less than 2% irregularity, while the $F_1$ of spring×winter varieties of *A. sativa* showed 14–31% of the cells having irregularities. In hybrids of *A. byzantina* with *A. sterilis*, *A. sativa* and *A. fatua* 59–88% of the cells showed irregularities. These results are prob-

ably comparable to those of Nishiyama (1929) who, in hybrids involving *A. byzantina* as one parent, found univalents in 29–33% of the cells examined, while in hybrids involving only *A. sativa*, *A. sterilis* and *A. fatua*, univalents were found in 5–16% of the cells.

From the above evidence it is clear that a high degree of homology exists between the genomes of the various hexaploid species. Nishiyama (1939) gave AABBCC as the genome constitution of *A. fatua* and it is probable that this applies to all the hexaploid species.

*Tetraploid×Diploid*—Meiosis in the triploid $F_1$ of *A. barbata×A. strigosa* was investigated by Nishiyama (1929) who found the close genome affinity of 1.041 between the two species. Usually 7 bivalents inclusive of trivalents were formed, but sometimes 8–9 bivalents inclusive of trivalents were found. The number of trivalents was 0–3 and rarely a quadrivalent was seen. However, at least 3 lagging univalents were found at metaphase I of all cells. Spier (1934) made the same cross and reported similar results, except that at least 4 univalents were found in all cells.

Nishiyama (1936) made a further study of the genome constitution of *A. barbata* by crossing it with a synthetic autotetraploid of *A. strigosa* having the genome constitution of AAAA. In the $F_1$ hybrid 12 bivalents were frequently found and sometimes 13. The number of univalents found varied from 0 to 5, but in most cases was 1 or 2. In an extreme case all chromosomes entered into pairing relations, forming 11 bivalents and 2 trivalents. Thus it is evident that one genome of *A. barbata* is completely homologous with genome A of *A. strigosa*, while the second is partially homologous to it. Nishiyama represented the genome constitution of *A. barbata* as AAB′B′.

Ellison (1940) reported the meiotic behavior of the triploid $F_1$ of *A. longiglumis*×*A. abyssinica*. The most frequent configuration found in 45% of the cells examined consisted of 5 univalents, 5 bivalents and 2 trivalents. Quadrivalents were rare, but each cell showed at least 1 trivalent or 1 quadrivalent. One cell had 4 univalents, 5 bivalents, 1 trivalent and 1 quadrivalent. As the meiotic behavior of this hybrid is very similar to that of *A. barbata*×*A. strigosa* and because the pairing in the $F_1$ of *A. barbata*×*A. abyssinica*, as discussed above, is very close, it seems certain that the genome constitution of *A. abyssinica* is AAB′B′. However, it is not clear whether *A. longiglumis* is AA or B′B′.

*Hexaploid*×*Diploid*—The meiotic behavior of the tetraploid $F_1$ of *A. sativa*×*A. strigosa* was reported by Kihara and Nishiyama (1932). The number of bivalents expected would be 7, while the number found ranged from 3 to 9 with the mode being 7. Multivalents found in the majority of cells had from 3 to 7 members. The same workers reported that in the tetraploid $F_1$ of *A. fatua*×*A. strigosa* the situation was similar, but with the pairing perhaps a little weaker. The number of bivalents ranged from 2 to 9 with the mode being 6. Among the multivalents one eight-membered structure was found. The multivalents were believed to be formed by the supernumerary chromosomes of *A. sativa* and *A. fatua* pairing among themselves. As it is impossible to tell how many bivalents are formed in this way, it cannot be considered as demonstrated that *A. strigosa*, *A. sativa* and *A. fatua* have a common genome.

On the other hand, Ellison (1940) reported that in the tetraploid $F_1$ of *A. longiglumis*×*A. sativa* there were usually at least 7 bivalents in each cell. Trivalent and quadrivalent formation were found to be less common

than in the triploid *A. longiglumis*×*A. abyssinica*. Thus it is possible that one genome of *A. sativa* is homologous to the genome of *A. longiglumis*, but we do not know whether the genome of *A. longiglumis* is A or B′.

*Hexaploid*×*Tetraploid*—Nishiyama (1929) studied pairing behavior in the $F_1$ pentaploid hybrids of *A. barbata*×*A. fatua* and *A. barbata*×*A. sterilis*. Chromosome pairing was generally found to be loose with the bivalents formed often mated only at one end. On the basis of full homology 14 bivalents would be expected, but in *A. barbata*×*A. fatua* 2–11 bivalents inclusive of 1–4 trivalents were found, while in *A. barbata*×*A. sterilis* 7–13 bivalents inclusive of 0–4 trivalents were found. The genome affinity between *A. barbata* and *A. fatua* was 0.456 and between *A. barbata* and *A. sterilis* it was 0.675. These figures are even more significant when it is recalled that the chromosomes of *A. barbata* can pair among themselves as can the chromosomes of the hexaploids.

Emme (1932) reported that meiosis in the $F_1$ of the two pentaploid hybrids *A. sativa*×*A. abyssinica* and *A. sativa*×*A. barbata* showed 7 to 9 bivalents. Similarly Spier (1934) reported that meiosis in the $F_1$ of *A. abyssinica*×*A. sterilis* showed 5 to 11 bivalents with 23 to 13 univalents per cell. Trivalents were sometimes found but not quadrivalents. These results agree with those of Nishiyama in indicating a very low homology between the genomes of the tetraploid and hexaploid species studied.

The lack of homology between the genomes of the tetraploids and hexaploids was further demonstrated by Lesik (1948) who obtained synthetic amphidiploids of *A. sativa*×*A. abyssinica* using colchicine. These plants had 35 pairs of chromosomes and 100% fertility. Ex-

amination of meiosis showed 35 bivalents were usually formed, but sometimes 2–3 univalents were observed.

### *Conclusions*

The evidence from cytology indicates that speciation on the diploid level in *Avena* has involved structural changes in the chromosomes, but these changes have not been extensive in the species so far investigated. Our ignorance of the genome constitution of many of the diploid species is complete.

The evidence indicates that the tetraploid *Avena* species have two partially homologous genomes which are also homologous to the genomes of the diploid species investigated. Whether the tetraploids are auto- or allopolyploids is not clear. Evidence on this point could readily be obtained by synthesizing tetraploids involving the various diploid combinations. The tetraploid species may have arisen independently or they may be derived from a common tetraploid ancestor.

The origin of the hexaploid species is obscure. While it is probable that at least one diploid *Avena* genome is present in the hexaploids, it is certain that *A. barbata* and *A. abyssinica* played no part. The identity of the tetraploid which did contribute two genomes to the hexaploids is a complete mystery. As with the tetraploids, the evidence from cytology does not indicate whether the hexaploids arose independently by allopolyploidy or whether the different species are derived from a common hexaploid ancestor or whether a combination of these processes has occurred.

## Part III. The Evidence from Genetics

Studies on the inheritance of taxonomic characters in the genus *Avena* have been largely restricted to the manner of attachment of the florets to the rachilla. The culti-

vated species of oats are distinguished from their supposed wild ancestors by the absence of floret-articulation. This distinction is not only important taxonomically, but economically, as it facilitates harvesting the grain, and biologically, as it deprives the cultivated species of self-propagating ability and makes them dependent upon man for continued existence. The modes of inheritance of the floret-attachment type of the cultivated oats afford valuable criteria for evaluating the various theories on the origin of the cultivated species.

### *Diploid and Tetraploid Species*

Jones (1940) made a study of the mode of inheritance of the floret-attachment types of diploid and tetraploid species. Four diploid crosses were made: *A. Wiestii* (wild) × *A. strigosa brevis* (cult.); *A. Wiestii* × *A. strigosa; A. hirtula* (wild) × *A. strigosa brevis* and Cc1795 (wild) × *A. strigosa brevis*. In each cross all individuals of the $F_1$ had the florets articulated, while the $F_2$ segregation indicated the lack of articulation of the cultivated species to be due to two pairs of recessive factors. The genotype of the wild species for these factors was given as XXYY and that of *A. strigosa* as xxyy.

In the tetraploid cross *A. barbata* (wild) × *A. abyssinica* (cult.) Jones found the $F_1$ to have all florets articulated, while the $F_2$ segregation indicated the solid floret-attachment of *A. abyssinica* to be due to four pairs of recessive factors. The genotype of *A. barbata* was given as XXXXYYYY and that of *A. abyssinica* as xxxxyyyy. Emme (1934) reported that in the $F_1$ of *A. abyssinica* × *A. Vaviloviana* the wild-type attachment of the latter dominated. The $F_2$ segregation was not given.

The sterile triploid $F_1$ of *A. barbata* × *A. strigosa* had the wild-type articulation (Nishiyama, 1929) as did the triploid $F_1$ of *A. longiglumis* × *A. abyssinica* (Jones, 1940).

Thus it appears that the cultivated diploid and tetraploid oats arose from their wild ancestors by recessive mutation. The geographic isolation of both species from the main populations of the wild diploid and tetraploid species has undoubtedly been an important factor in the evolution of these oats.

## *Avena sativa*

The common cultivated oat is generally believed to have arisen from *A. fatua*, In addition to its lack of floret-articulation, the cultivated species is distinguished from its putative ancestor by lacking prominent hairs about the base of the lemma and by having greatly reduced dorsal awns. The inheritance of these characters in crosses between the two species has been investigated by many workers (see Huskins, 1946) and the combination of characters behaves genetically as if due to a single gene or gene complex. The $F_1$ is intermediate between the two parents in having a twisted geniculate awn only on the lower floret, while the pubescence and articulation-surface are much reduced compared to *A. fatua*. The $F_2$ segregates in the ratio 1 *sativa*-like : 2 intermediate : 1 *fatua*-like for these characters.

Considerable light has been shed on the nature of the genetic factor governing the distinction between these two species by the study of fatuoids or false wild oats. This problem has been extensively reviewed by Huskins (1946), so only the barest outlines will be presented here. Fatuoids are derivatives or "off types" of *A. sativa* which arise spontaneously in many varieties of the cultivated oats and resemble *A. fatua* in type of floret-articulation, grain-pubescence and awn-development, but resemble the variety from which they arose in all other characters. Huskins presents convincing evidence that fatuoids are caused by chromosome aberrations which give rise to

plants deficient for the factor expressing the cultivated-type grain characters. Sometimes the fatuoids lack the entire chromosome which carries this factor. It is evident that *A. sativa* has all the genetic factors necessary to produce the *A. fatua* grain characters, but in addition it has a partially dominant inhibitor which suppresses the development of the *fatua* grain characters and produces the cultivated-type grain. This inhibitor is designated the C-factor and the chromosome on which it is located is called the C-chromosome.

The C-factor of *A. sativa* has been found to be partially dominant in crosses with wild species other than *A. fatua*. Florell (1931) reported that in crosses of *A. sativa*×*A. sterilis* the *sativa*-type attachment of the lower floret (spikelet) was almost completely dominant over the wild type and due to a single factor. Jones (1940) found the $F_1$ of the crosses *A. longiglumis*×*A. sativa* and *A. sativa*×*A. barbata* to have non-articulate florets.

Theories accounting for the origin of *A. sativa* must agree with the genetic facts. Since the *sativa* grain type is due to a single factor pair, only one intermediate form is possible between the wild and cultivated grain types. This would be due to the heterozygous condition. An extensive series of intermediate forms from the wild species to *A. sativa* showing gradual reduction of the articulation-surface of the florets, reduction in pubescence, or reduction of awns has nothing to do with the origin of *A. sativa*. Far from solving the problem, such intermediate forms raise the additional question of their own origin. Similarly the facts of genetics are at variance with the opinion of Coffman (1946) that an origin of *A. sativa* from *A. sterilis* requires only loss mutations, while an *A. fatua* derivation requires additive mutations which are believed to be more difficult to obtain. The evidence indicates that both *A. sterilis* and *A. fatua* lack the C-

factor, and the derivation of *A. sativa* from either would require an additive mutation.

## *Avena sterilis*

The wild red oat is distinguished by having the lower floret of a spikelet articulated, while the upper florets are not. When the upper florets are separated by fracturing the rachilla, most of the rachilla segment remains attached to the floret above. This character was used by Cosson as the basis of his series *Biformes*.

Like the C-factor of *A. sativa*, genetical studies have shown this *Biformes* character to be due to a single dominant gene, here called the B-factor. Tschermak (1929) reported that in the $F_1$ hybrids of *A. fatua*×*A. sterilis* the B-factor was completely dominant and the segregation of later generations showed it to be due to a unit factor difference. Similarly Florell (1931) reported that in various crosses of *A. sterilis* with *A. fatua* the B-factor was dominant in the $F_1$, while the $F_2$ segregated in the ratio of 3 *sterilis*-like : 1 *fatua*-like for this character.

Florell also crossed *A. sterilis* with *A. sativa* and found the $F_1$ plants to have non-articulate lower florets (spikelets) as in *A. sativa*, as well as non-articulate upper florets as in both parents. However, when the upper florets were separated by fracture, the rachilla segment remained with the floret above as in *A. sterilis*. The $F_2$'s segregated in the ratio of 1 *sativa*-like : 2 intermediate, like the $F_1$ : 1 *sterilis*-like, indicating linkage for the B- and C-factors. No cross-over plants were found.

Nishiyama (1935) obtained further evidence on the nature of the B-factor by crossing *A. sterilis* with a heterozygous fatuoid from *A. sativa* having only one C-chromosome. Plants were obtained in the $F_2$ which had 40 chromosomes, thus lacking the C-chromosome entirely. Such plants were fatuoids having the grain char-

acters of *A. fatua*. Thus it was demonstrated that the B-factor is carried on the C-chromosome. Whether or not the B-factor is an inhibitor of the *A. fatua*-type of upper floret-articulation is unknown, as fatuoids have not been observed in *A. sterilis*.

*A. sterilis* has the distinction of being the only hexaploid species which has not been theoretically derived from some other hexaploid *Avena* species now living. If it arose independently by allopolyploidy, one can scarcely resist suggesting *A. Bruhnsiana*, with its large spikelets and non-articulated upper florets, as the diploid ancestor.

### *Avena byzantina*

The nature of the genetic mechanism controlling the grain characters of the cultivated red oat is by no means clear. Some forms of this species seem to have both the B- and C-factors on the same chromosome. This is true of cultivar Fulghum which Florell (1931) crossed with *A. fatua*. The $F_2$ segregated in the ratio of 3 *byzantina*-like to 1 *fatua*-like for the grain characters. Among the 478 plants of the $F_2$ were 4 cross-over progeny resembling *A. sterilis* and 3 resembling *A. sativa*. Stanton et al. (1926) found fatuoids arising from Fulghum and Burt to resemble *A. fatua*, indicating that the B- and C-factors were inhibiting the development of wild-type genes possessed by those varieties.

*A. byzantina* cultivar Coastblack, however, seems to have the B- and C-factors on the same chromosome, as well as an additional B-factor on another chromosome. In the cross Coastblack×*A. fatua* Florell (1931) obtained an $F_2$ ratio of 12 *byzantina*-like : 3 *sterilis*-like : 1 *fatua*-like for the grain characters.

Bond, which is said to belong to *A. byzantina*, has no C-factor at all, but has the B-factor, as is shown by the work of Hayes et al. (1939), Torrie (1939) and Ko

et al. (1946). The spikelets of Bond shatter readily.

Coffman et al. (1925) made an extensive study of variability in *A. byzantina* cultivar Burt and found a most confusing array of forms. Some plants had the lower floret (spikelet) articulated while others did not. In some plants the rachilla segment when fractured remained with the floret above, in others it remained with the floret below, while in still others it fractured near the middle, parts remaining with both florets.

Mal'tsev (1929) and Mordvinkina (1936) state that all the florets of *A. byzantina* are non-articulate, while the latter author is able to distinguish between the grains of *A. sativa* and *A. byzantina* by the angle of the fracture-surface of the lower florets. If his *A. byzantina* has the C-factor, the difference between it and *A. sativa* might be due to the C-factor being superimposed on the different genetic backgrounds of the two species. The alternative is that non-articulate florets in many varieties of *A. byzantina* are due to other genetic factors than the C-factor. Clearly more information is needed before definite conclusions can be drawn.

## *Avena fatua*

The genetic evidence indicates that the factors governing complete floret-articulation of the wild oats are inhibited by the B- and C-factors. It is sometimes assumed that the articulation factors of *A. fatua* are located on a single chromosome which is called the B-chromosome. There is no evidence for this, it being probable that many factors on many chromosomes are responsible for the grain characters of *A. fatua.*

It is generally believed that *A. fatua* is the progenitor of *A. sativa* and, as stated earlier, their parallel variation and geographic distribution speak for a close relationship between the two. However, no one has observed any

strain of *A. fatua* to mutate to *A. sativa*. Vavilov (1926) noted that no attempt to cultivate *A. fatua* would induce it to lose its brittle manner of floret-attachment. Coffman (1946), stated that, despite the fact that *A. fatua* is a common weed of fields and fence rows in the western United States, there is no evidence of any cultivated form having arisen from it.

On the other hand, both *A. byzantina* and *A. sativa* have given rise to fatuoids resembling *A. fatua*, and Coffman (1946) stated that he was inclined to believe the origin of *A. fatua* paralleled that of the fatuoids. Earlier (1936) Stanton wrote: "To one with imagination, the occurrence of fatuoids might be considered a provision of nature to return cultivated oats to wild forms, thus making them self-propagating in case, through some disaster, the cultivated forms were no longer in the hands of human beings."

If it is true that *A. fatua* arose from cultivated oats and if all cultivated oats arose from *A. sterilis* and if the cultivated oats are not self-propagating, then *A. byzantina*, *A. sativa* and *A. fatua*, including a total of eleven subspecies, have evolved within the period of man's agricultural activities. This would be exceedingly explosive evolution.

## *Conclusions*

The evidence from genetics indicates that the lack of floret-articulation of the diploid and tetraploid cultivated oats is due to different genetic factors than the similar character of the hexaploid cultivated species. It may be concluded that different evolutionary forces have produced similar results in the two subsections. Although it seems probable that recessive mutations and geographic isolation have produced the diploid and tetraploid cultivated species, the mode of origin of the hexaploid cultivated oats is by no means clear. The final decision on

the origin of the hexaploid species will have to await the discovery of their tetraploid ancestor(s).

Much work remains to be done in determining the genetic mechanism controlling taxonomic characters other than floret-attachment type. Such studies may provide critical information for evaluating Mal'tsev's system of classification. Indeed, it is now known that the B-factor controls the distinction between *A. sterilis sens. ampl.* and *A. fatua sens. ampl.* Species based on a single gene difference may not be too valid.

## Part IV. Oats and Man

Oats, the fourth most important cereal crop of man, has been profoundly affected by its association with man. Let us, therefore, turn our attention to this association in the hope of learning when, where and how it began and by what means it may have affected the evolution of oats. Archaeology, written history and the present agricultural practices of conservative peoples throw light on this aspect of the problem.

### *Archaeology*

What are probably the oldest known oat grains were found in Egypt associated with remains belonging to the 12th Dynasty (Täckholm et al., 1941). Similar grains have been found among Egyptian cereals of the 2nd and 3rd century A.D. These Egyptian oats were originally identified as *A. strigosa*, but Täckholm et al. think they are *A. fatua* or *A. sterilis*. It would appear that they occurred as weeds, there being no evidence that oats were cultivated by the ancient Egyptians (De Candolle, 1883; Ames, 1939).

Archaeological evidence for the early presence of oats in northwestern Europe is abundant. Werth (1944) lists three sites in Switzerland, five in Germany and one in

Denmark in which *A. sativa* grains have been found for the period 2000–1000 B.C., and there is an unbroken series of finds for that species from 1000 B.C. to the present. *A. strigosa* also occurred in Europe during the Bronze Age, as grains of that species from one site in Switzerland and one in adjacent France have been identified by Mal'tsev (Jessen and Helbaek, 1944).

Oats appear to have reached Britain somewhat later, with the earliest samples of *A. strigosa* or *A. brevis* and *A. sativa* dated about 150 B.C. (Jessen and Helbaek, 1944). Early remains of oats from England are always found mixed with larger samples of wheat and barley, suggesting the oats were weeds. Samples from Scotland, however, are almost exclusively oats. Oat culture in Britain seems to have increased following the Anglo-Saxon invasions and *A. fatua* appears in grain samples from this period.

### *Written Records*

The written history of oats begins with the Greeks and Romans. According to Stanton (1936), Theophrastus, Cato, Cicero, Ovid and Varro knew oats only as a weed which was sometimes used for medicinal purposes. Thus oats were not cultivated in the ancient world of those writers, and De Candolle (1883) reported that oat culture was not introduced to Greece and Italy until the latter half of the Roman Empire. However, Columella and Pliny (Werth, 1944) indicate that the German barbarians ate oatmeal, and De Candolle interpreted the remarks of Pliny to indicate the Romans were not acquainted with its use. Also Galen wrote (according to De Candolle) that oats abounded in parts of Asia Minor where they were fed to horses, but were also eaten by men in times of distress. Other records for the early culture of oats in the Near East are wanting. Moldenke and

Moldenke (1952) have found no reference to cultivated oats in the Bible; there is no evidence that oats were grown in ancient Mesopotamia, nor are they grown in that region today. In China, however, De Candolle reported that naked oats are first mentioned in a history treating the years 618 to 907 A.D.

Archaeology and history indicate that *A. strigosa* and *A. sativa* were cultivated in northern Europe from 2000 B.C. on. However, the evidence is very incomplete from the Near East where Vavilov placed the center of origin of hexaploid cultivated oats. The evidence does indicate that oats at first were weeds, especially of other cereals, and even today *A. sativa* ssp. *macrantha* is not cultivated as an independent crop. This brings us to another aspect of the problem.

### *Oats as Weeds*

Vavilov (1926) reported collecting many samples of emmer wheat from the several scattered localities where that ancient crop is still grown. There were samples from the Basques of the Pyrenees, from Abyssinia, Bulgaria, Asia Minor, the Crimea, the Caucasus, Iran and parts of Russia. One hundred samples of emmer from these localities proved to have admixtures of some *Avena* species, many of them unique varieties. Vavilov came to speak of oats as the unfailing attendant of emmer and concluded the history of oats was intimately connected with that of emmer. He visualized emmer spreading over the Old World and carrying with it an assortment of oats as weeds. When they reached the harsher climates of the north, oats, being the hardier plant, supplanted emmer and became an independent crop. In this connection Werth (1944) stated that emmer with its attendant oats was a widespread crop in northern Europe during the time of the Climatic Optimum. When the climate

began to deteriorate (from about 2000 B.C. on, according to Werth), the oats were better adapted to the changed conditions and supplanted the emmer.

The existence of oats as weeds of other cereals undoubtedly has had a profound influence upon the evolution of the genus. In the first place any mutation in a wild weed-oat causing non-articulate florets would have a selective value, as those grains which did not fall would be harvested with the main crop and planted next year. Similar mutations arising in the wild would be lethal.

Some species of the genus, with man as an agent of dispersal, have spread far from their native homes. No doubt *A. strigosa* and *A. abyssinica* achieved geographic isolation in this way, while *A. sativa* and *A. fatua* have encircled the globe. These species have achieved vastly larger populations than they would have otherwise, and the survival of new mutants under differing ecological conditions must have added greatly to the total variability of the species. In addition, the dispersal of oats by man probably has brought together species which were once isolated geographically, thus facilitating hybridization. At present we can but dimly see how this process has added to the variability of *A. sterilis* and *A. fatua*, but perhaps it explains why *A. sterilis* ssp. *Ludoviciana* resembles *A. fatua*, within whose range it lies, while *A. fatua* ssp. *meridionalis* which lies within the range of *A. sterilis* has the largest spikelets of the *fatua* group.

## *Modern Oats*

It is fitting to end this review with a tribute to the many oat breeders who, during the past half century, have dedicated themselves to the never-ending battle against parasitic fungi. It has been found that the primary sources of disease resistance in oats are *A. byzantina* and *A. sterilis* (Coffman, 1946), and oat-breeding projects

have been largely concerned with transferring this resistance to varieties of *A. sativa*. Stanton (1947) gave a graphic account of a portion of this work by tracing the history of a single seed which resulted from an *A. byzantina*×*A. sativa* cross made in 1930. The descendants of this seed proved superior to the oats then grown and it is estimated that in 1946 they accounted for two-thirds of the oat acreage in the United States. As pointed out by Coffman, cultivated oats will come to contain more and more genes of *A. byzantina* with the advance of oat-breeding projects. The days of pure *A. sativa* appear to be numbered and we can well imagine that a phylogenist of the future will be able to assemble an extensive series of intermediate forms which, if their true origin were ignored, would suggest *A. sativa* originated from the red oats.

## Conclusion

Scarcely any definite conclusions, other than broad generalizations, can be drawn as to the origin of oats. Objections raise themselves to every theory. However, the broad outlines of oat evolution are becoming evident, and, with the accumulation of more information, a much more satisfactory picture will develop. A measure of the progress to date can be gained by comparing the evidence reviewed here with notions held during the eighteenth century when, according to De Candolle, the prevailing opinion was that oats originated in the South Pacific on the Isles of Juan Fernandez.

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